# ENGINEERING LITERATURE

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## CONTENTS.

| | Page |
|---|---|
| EDITORIAL: | |
| The Lack of Books on the Care of Engineering Works.—Core Wall and Core Plate.—Engineering Terminology | 37 |
| CORRESPONDENCE: | |
| Traffic and Travel, Together with Thoughts on Engineering Terminology.—Some Criticisms of Technical Books.—Books on Water Analysis, Water Softening, Boiler Construction and Steam Engineering.—How to Distinguish Common Forest Trees.—A Universal Log Measurement Rule. | 38, 39, 52 |
| REVIEWS: | |
| The Elasticity and Resistance of the Materials of Engineering. Reviewed by Prof. Edgar Marburg | 39 |
| Plain Directions for the Care of a House | 40 |
| Friction and Lubrication | 40 |
| The Metallography of Iron and Steel. Reviewed by Wm. R. Webster. | 41 |
| The Commercial Woods of the World | 41 |
| A British Text-Book on Water Supply | 41 |
| Electrical Machinery Mathematically Considered | 42 |
| Non-Metallic Minerals | 42 |
| Artificial Building Materials | 42 |
| Journal of the Iron and Steel Institute | 42 |
| Aerial Telephone Lines | 42 |
| Graphic Statics. Reviewed by Prof. H. S. Jacoby | 43 |
| Electricity on Shipboard | 43 |
| Master Car Builders' Association | 43 |
| Master Mechanics' Association | 43 |
| Illinois Society of Engineers and Surveyors | 43 |
| Railroad Curves, Earthwork and Tables | 44 |
| Modern Practical Electricity | 44 |
| Mississippi River Bridges | 44 |
| A Directory of Wealth | 45 |
| Reports on Railway Topics | 45 |
| Uniform Municipal Accounting at Boston and Elsewhere | 45 |
| Public Health Reports | 45 |
| Geographic Tables and Formulas | 45 |
| Rainfall and Run-off in the United States | 46 |
| Two British Mechanical Engineer's Pocket-Books | 46 |
| American Public Health Association | 46 |
| Wireless Telegraphy | 46 |
| American Water-Works Association | 46 |
| American Society of Municipal Improvements | 46 |
| Pneumatic Power Transmission | 47 |
| Testing Dynamos and Motors | 48 |
| The Architects' Directory | 48 |
| Planning High-Speed Electric Railways | 49 |
| A Maintenance-of-Way Pocket-Book for Indian Railways | 49 |
| The Ohio River as an Historic Highway | 50 |
| Reports on the American Occupancy of Cuba | 50 |
| American Street Railway Association | 50 |
| Literary Magazines | 51 |
| Mechanical Drawing | 51 |
| Commutator Construction | 51 |
| Plans of Structures on Irrigation Canals | 52 |
| Publications Received. | 52 |

An unusually practical book, designed primarily for householders, is the "Care of the House," reviewed elsewhere in this issue. It may well serve as a reminder of the rarity of books on caring for things as compared with those on designing, constructing or acquiring them. In engineering there are numerous books, for instance, on constructing water-works and pavements, but few or none on their maintenance. The time will come when this disparity will be lessened, if not reversed.

The use of steel plates to ensure the watertightness of both rock fill and earth dams adds both interest and difficulty to any attempt which may be made to settle on a generic term to denote the barrier against the passage of water through all dams constructed of readily pervious material. Until the adoption of steel plates for such barriers the materials used were practically confined to puddle, concrete and rubble masonry. Barriers of these materials were, at least in America, rather indifferently termed core walls, heart walls, and occasionally center walls, while puddle wall was often deemed sufficient when the barrier was of that material. In the many descriptions of earth dams included in "The Manual of American Water-Works" the term heart-wall was used, and to a large extent that word has been employed for many years past in Engineering News. We are now inclined, particularly in view of the recent use of steel plates to secure water tightness, to prefer core as a generic name for all such barriers placed in readily pervious walls. This may be qualified as circumstances demand to indicate the character of the core, resulting in wall or plate as specific terms, and puddle core wall, concrete core wall, or rubble masonry core wall, on the one hand, and steel core plate on the other to denote varieties. For brevity, where there is no danger of confusion, wall or plate may be dropped, but probably core should be invariably retained, since barriers for water tightness may be placed otherwise than along the center line of a dam, in which case they would no longer be *core* walls or plates. The word core, as applied to dams, already has a generally recognized meaning, and by its universal use one short word, prefixed by an affirmative or negative, would indicate whether or not a special water barrier was provided at the center of a dam, while other short words would clearly describe, when desired, the character of the barrier. The result would be both clearness and brevity, two essentials of engineering terminology.

An engineer whose letter we print below makes some pointed criticisms on technical books. Some of these criticisms will be seen to depend for their force on relative points of view. Different persons will require different service from a given book. Some persons will want only those portions of the book which cannot be found anywhere else in engineering literature, and will consider the other portions useless repetition. Others will require fairly full explanation of everything connected with the subject, and will appreciate the addition of a set of instructions for using the slide-rule or logarithms. Between these two extremes there is a wide range of opinion.

It is worth considering, in this connection, for what classes of readers technical books should be and actually are written. Many books, in fact too many, are written expressly for students in engineering colleges, as our correspondent complains. A common fault with a book of this kind is that the style and method of treatment are such that the book requires to be digested in the classroom and supplemented with explanations and illustrative lectures. In some cases the simpler portions are given in full elaboration, while the really important and difficult portions are treated synoptically, to be elucidated in the classroom. In other cases, the difficult parts alone are given, while all preliminary explanation and definition is left out, being assumed to be supplied by the student's previous study, or possibly intended to be given in lectures with experimental demonstration. In whichever way the book is unbalanced, it loses its value as a study-text for the general reader. It would seem that every technical book should be so logical, clear and complete, in treatment and language, that anyone possessing a reasonable amount of general knowledge can read the book understandingly without excessive difficulty.

We have repeatedly had occasion in previous issues of the Engineering Literature Supplement to point out examples of needlessly involved statement or explanation found in books written primarily for engineering students. Let us add another example: A book noted in this present issue opens its second chapter, on Electrical Units, with the following sentence:

> The dynamic character of electromagnetic action is so much in accord with common mechanical experience that the electromagnetic actions have been chosen to form the basis for the definition of a system of absolute electrical units.

Which sentence, we hold, means rather less than nothing.

Speaking more generally, it may well be claimed that books should in most cases be written primarily not for the student, but for the practicing engineer. When such a book is then to be used as a classroom text it may be cut down or supplemented as the individual teacher may desire. We might even go so far as to say that when there is no need for a book on a given engineering subject except for the use of college instruction, then there is no excuse for its existence.

The question of what should be included in a book dealing with a given subject, and what omitted, admits of radical differences of opinion, even after it is decided what class of readers the book is intended to serve and what amount of preliminary knowledge it should presuppose. We would suggest that a book on any particular branch of engineering should cover the full extent of that branch, in greater or less detail of statement according as it is intended to reach a better or less well-prepared circle of readers. The range of the subject should be clearly defined; its practical extent should be indicated and the more purely theoretical ramifications placed in proper relative position.

All portions of the subject should be treated in equal detail, i. e., the book should be balanced (except as this is modified by reference to the demands of practice). On the other hand, the line should be drawn sharply at matters that do not belong to the special subject under discussion. A book on elevated railway construction should not discuss the proper way to prepare concrete. A work on the design of electrical machinery should not explain how to mold in greensand, though it may discuss the quality of cast iron in relation to magnetic properties. If definite limits of this kind are not fixed, a book might be expanded to almost any degree. And it is not always easy for an author to recognize these limits; an extreme example, where irrelevant matter intrudes to the nearly complete exclusion of the proper subject-matter, is Dibdin's "Public Lighting by Gas and Electricity," reviewed in our July issue. As already remarked, however, opinions as to what should be included in a book may differ widely, often with equal plausibility in favor of each side.

### Engineering Terminology.

Words are among the most potent instruments at the command of the engineer. By their proper use he makes clear his meaning to clients and contractors, convincing the one of the wisdom of his propositions and binding the other to execute them. Through the improper use of words the engineer lessens his chances of making himself understood by clients, assistants and contractors, and provides loopholes for the latter to evade their obligations. Carelessness in the use of words may even lead to the ultimate confusion of the engineer himself. If these statements apply to words in general they are doubly applicable to technical terms.

The foregoing reflections are in part suggested by the notes on the misuse of certain technical terms which have appeared in the two preceding issues of this Supplement, and in part they are prompted by the letter from Mr. Samuel Whinery, M. Am. Soc. C. E., printed in the Correspondence columns of this number. What Mr. Whinery says regarding our recent note on "Traffic" and "Travel" is discussed in a note immediately following his letter. With his general proposition, that greater precision in the use of engineering terms is necessary, we are of course in most hearty agreement. We believe with him that dictionaries should define and not dictate, and that, knowing the limitations of those dictionaries in much that relates to engineering words, they should not be slavishly followed by engineers.

As Mr. Whinery suggests, there is unquestionably much carelessness displayed by engineers and engineering writers in their use of words to designate specific engineering ideas. In most cases, it is true, the context is such as to prevent any misunderstanding as to the idea intended; but this is only scant justification for the careless use of words, for it means that the reader must gather from several words or sentences the idea which should have been conveyed clearly by a single word. In order to use technical words more carefully it is not necessary that a precise code of engineering terms be established, to be followed in all engineering writings. The method of development of engineering terminology and its

status at any one time does not permit this. The objects and phenomena with which engineers deal are in most cases not specialized scientific facts, to be given a Latin name and discussed in abstruse language; rather they are things with which men in general are more or less familiar and to which in many cases they have already given names. When the engineer comes to dea with them, he generally takes over the word that is already in the language; he may, later, extend its meaning to cover analogous ideas, or he may restrict it to a specialized phase of the original idea, to suit his needs. When the word in the final meaning thus developed comes into general acceptance among engineers, it then forms part of recognized engineering terminology. At any one time, of course, there are many words which are still in process of formation or development; different writers use them differently, and they usually also have an established meaning in our general vocabulary. It is desirable that the technical use of the word should follow as closely as possible its more general use; the modification of its meaning for technical purposes must be arrived at gradually by the tacit agreement of those who use it.

It is important to note, also, that a definite technical term may have varying meanings when applied to different cases. Thus, the foundation for a column is generally a mass of stone, concrete, etc., upon which the column rests by means of a base or shoe; but the masonry foundation may, in its turn, be supported upon an artificial foundation, on piling or on a caisson. The ultimate foundation upon which the caisson rests is the hardpan or rock upon which it is designed to rest its load. Clearly, foundation used alone is a generic rather than a particular term. But it is not always advisable to coin specific words for each of the separate ideas to which a word may be applied. At least the necessity for a specific name in any one case must become clearly apparent before seeking for a name. And functionally the generic word (in our example the word foundation) will still correctly apply to each of the elements considered. What each writer of engineering can do, however, is to specify his meaning clearly in every case, instead of caresiessly using the word foundation with its different meanings in successive sentences.

The deliberate creating of specific engineering terms is, it will be evident, not an easy matter, and we think it would in most cases prove not only thankless but also valueless. A recognition of this fact gives added importance to the need for greater care in the use of engineering terms.

In the choice of words the chief object of the engineer should be to make himself understood; not in New York or San Francisco alone, but by the capitalist, manufacturer, contractor or their engineering representative in any city of the land, and possibly in other countries as well. If, then, the engineer can find a word ready at hand which is in common use and of an unmistakable meaning, he will generally do better to adopt it than to try to introduce, unless he can count on a wide and hearty professional co-operation, some other word which is more correct from the etymological viewpoint. If there is no well-established usage, or if a great work like the "Technolexicon" of the German Society of Engineers is in progress, then it will be most commendable to try to unite the profession on the better of two existing terms, or to try to introduce a still different and more accurate word.

Where a word is in use, even if quite generally, which has been badly perverted from its original and proper meaning, and which in the absence of qualifying or explanatory words might actually mislead, then an attempt may well be made to put down such a use of that word. One example of such a perversion is the use of watershed to denote an area, instead of a line bounding an area, as discussed in our issues of Sept. 17 and Oct. 15. It is conceivable, however, that even this word might become so universally used and understood as to make its continued use permissible or even desirable, but this is not yet the case.

We hope to see this discussion continued, more particularly in reference to the use and misuse of specific words.

## CORRESPONDENCE.

### Traffic and Travel, Together with Thoughts on Engineering Terminology.

Sir: As I am probably the engineer to whom you refer in the Engineering Literature Supplement of Oct. 15 as an advocate of the use of "street travel" instead of "street traffic" to designate the passing of vehicles along streets, may I ask a little space to discuss the matter; and will you pardon me if I do not adhere very strictly to the text?

I am well aware that all the leading dictionaries sanction the use of the word "traffic" to describe the passage of persons, horses and vehicles over streets. That is, however, no sufficient reason for not adopting a more exact and satisfactory word to describe, in a technical sense, the action referred to. The meaning of technical terms and the nomenclature of engineering, accepted by the profession, is not always in accord with the definitions of the dictionaries. It is a well-recognized fact, however, that the engineering profession has been more careless than any other in the adoption and use of accurate technical terms. Engineering News has, very laudably, called attention to many instances of this carelessness, and urged reform. In other professions—as, for instance, that of medicine—a clearly defined, accurate and scientific system of nomenclature and technical words and terms was long since adopted and put into use, and the dictionaries, whose function it is to define rather than to dictate, have taken note and framed their definitions accordingly.

The lack of an established, precise meaning of engineering terms, and the confusion that results therefrom, is brought to the mind of engineers almost daily. I have to-day been writing to a client about foundations, and I was confronted by the fact that the word "foundation" as now used, covers either the base of a structure, or the earth or other material on which that base rests; also that the word "caisson" is indifferently applied to at least two classes of structures, quite different from each other in construction and function. Not long since I was a witness in an important lawsuit, where the meaning of the word "diagram" was differently defined by each of three eminent engineers, and I found that my own understanding compelled me, reluctantly, to add a fourth definition. Perhaps this lack of precision is nowhere better exemplified than in the terms used in the drafting (or shall I say draughting, or drawing?) room. The designs for a building, for instance, are collectively called "the plans," but in another sense only the horizontal projections are plans. Some draftsmen make "front views" and others make "front elevations." Some prepare "plats," while others get up "plots,"—though innocent of any attempt at intrigue or mischief. Most of us use the good and useful word "batter" to designate the deviation of a wall from the vertical, but we do so without the sanction of the dictionaries. (The Century Dictionary does give this meaning for batter, at least in its use as a verb.—Ed.)

The trouble has been that thoughtful engineers, while deploring the woeful lack of precision in the professional vocabulary, have taken no effective measures to remedy the defects. Instead of adopting, or, if necessary, creating suitable technical words and terms, defining them exactly, and adhering to them, they go to the dictionaries and accept what they find. That this is all wrong few will deny.

Why not then, as opportunity offers, introduce and encourage the use of words or definitions that will describe accurately and distinctively just what we mean? If, as admitted, the word traffic, as defined by the dictionaries, means trade or commerce, as well as that use of streets which wears out pavements, why not, in the interest of technical exactness, adopt the word "travel" to designate that particular thing, and thus differentiate it from shopping or selling groceries? The dictionaries will in time recognize the distinction. They should be our servants, not our masters. S. Whinery.

95 Liberty St., New York, Oct. 19, 1903.

(Some of the broader questions raised by our correspondent have been discussed in the editorial columns of this Supplement. In continuation of the discussion of traffic and travel to designate the movement of horses and vehicles along streets we cannot, to say the least, see any more justification for travel than for traffic.

What is desired is a term that will clearly express the number of units causing the wear and tear of streets. The word travel implies persons and distance, and is employed only colloquially to denote the movement of persons, and rarely if ever includes goods or objects of trade. Traffic, whatever its original meaning, is now universally accepted to denote the movement of either passengers or goods, employing as units individuals in the case of passengers, and weight or volume or numbers of vehicles in the case of goods. As applied to the wear and tear of streets, weight is an essential element, and a term which naturally takes cognizance of weight is desirable.

Moreover, the proposed term "travel" has itself a definite specialized meaning in engineering use. The travel of a lathe-carriage is its motion in a specified direction; the travel of a reciprocating slide is its length of path, etc. Here, also, only distance is meant.—Ed.)

### Some Criticisms of Technical Books.

Sir: The writer is one of the engineers referred to in "The Criticism of Technical Books," in the Engineering Literary Supplement of Oct. 15, who makes marginal comments on his books. He welcomes your invitation to make a few remarks on technical books in general.

Too many books are being brought out which are written by professors or instructors and are only partial books. Why are they advertised and sold at fairly good prices to the profession at large if they are really only intended to supplement lectures? Why not print them on thinner paper with cheaper binding for the benefit of students? If the sale to students will not be large enough to pay the cost and outside purchasers must be found, why not make the books complete?

"Statics by Algebraic and Graphic Methods" (L. J. Johnson) was a distinct disappointment to the writer. It is very cleverly written and a child can understand it. Yet it is incomplete. A man after closely studying it is no better off than the man who possesses one of the numerous good pocket books of the steel companies with their line diagrams and pages of tables. On page 108 the author says: ". . . the Fink Truss has some practical merits which cause it to be widely used." What are they? A lead pencil marginal note (by the writer) says "see pp. 6 and 9 Tyrrell's "Mill Building Construction." A reference there to p. 6 shows us that "Partial loading can never cause maximum strains in the parts of a Fink truss as they may in other forms of roof trusses." A reference to p. 9 shows ". . . it is economical because most of its members are in tension and the struts are short." Why did not Professor Johnson say those things in his book?

He gives one page to "Stresses due to Moving Loads," and then refers the reader for further particulars to a list of books which will cost just $35 to buy, and does not recommend one book more than another. Yet many men will purchase Professor Johnson's book to find out all about bridge trusses.

Prof. Jerome Sondericker is out now with a book on "Graphic Statics" which covers exactly the ground covered in the book by Professor Johnson, eliminating the algebraic work, and stopping again with roof trusses. Simple little A B C problems elucidated in the most elementary works, yet nothing in the advertisements or title pages leads us to look for primers. While these gentlemen were about it why did they not add a few pages and make their books fairly complete? A model would be the little book "Graphic Statics," by Professor Van Ott, bearing on its title page the date 1876, yet unsurpassed to date for its concise treatment of all forms of trusses, and sold at a reasonable price—50 cts. cheaper than either of the two later books mentioned above.

The writer has quite a library of books dealing with statics and can praise the two books as far as they go. It is such books that give point to the arguments presented by correspondence schools against unsatisfactory home study. Professor Greene's "Structural Mechanics" is a sketchy note-book treatment of the subject indicated in the title, and "Radius of Gyration" is not mentioned in it anywhere. Yet it is very valuable to a man already possessed of some experience.

In reviewing Ketchum's "Design of Steel Mill Buildings" (Oct. 15, 1903), you criticise the author for going so much into detail on the subject of calculating stresses. Your criticism will lead many to buy the book who would otherwise not have thought of doing so. It is a good fault to go into detail on a few things a man may have forgotten. If he has not forgotten them he can skip those chapters. For a man who has never studied the subject of stresses the book will be more valuable because of those chapters. The writer was employed for a short time this year in an office containing 12 draftsmen. His sole duty was to compute stresses in such structures. Each of the draftsmen was competent to make all the drawings, but dependent upon pocket-books to figure stresses. When the head draftsman found the writer enjoyed such work he had him transferred from field work temporarily to assist in the office. The draftsmen at first resented the employment of "a surveyor" to assist them. Ketchum's book will have a good sale in that office for the writer has blue-penciled your criticism and mailed it there.

A professor's book is apt to be sketchy. A practitioner's book is apt to be too detailed. A model book for students and practicing engineers is Fanning's "Water Supply Engineering." Why does he not thoroughly revise it? All technical books should adopt Fanning as a model. Searles' "Field Engineering" is another model of style in theoretical and practical treatment. Engineer.

Chicago, Ill., Oct., 18, 1903.

(We trust that others will express their views of technical books through these columns as freely as has this correspondent. The general discussion of the criticism of technical books begun in our is-

sue of Oct. 15 is continued, with special reference to some of the points urged in the foregoing letter, in a note printed on our editorial page.—Ed.)

## Books on Water Analysis, Water Softening, Boiler Construction and Steam Engineering.

Sir: We are desirous of obtaining a standard work on the analysis of water for steam boiler purposes, together with suggestions for the prevention of scale with different classes of impure water.

We would consider it a favor if you could suggest any publication of this kind which has come under your observation, together with other standard works treating of the best practice on boiler construction and steam engineering.

Cahall Sales Department,
Edw. P. Moritz, Southern Manager.

Atlanta, Ga., Oct. 24, 1903.

(We do not know of a book devoted to the analysis of water for boiler purposes, but most if not all the books on the chemical analysis of water treat the subject briefly. Small, handy volumes of this sort are Prof. Henry Leffman's "Examination of Water for Sanitary and Technic Purposes" (3d ed., New York, 1895; $1.25); and Prof. Wm. P. Mason's "Examination of Water" (New York, 1899; $1.25). Professor Leffman's book contains suggestions for the treatment of water for industrial purposes. Water softening, as well as water purification in its various phases, is discussed in F. E. Turneaure and H. L. Russell's "Public Water Supply" (New York, 1901; $5). Harold Collets' "Water Softening and Purification" (London and New York, 1895; $2) is a small book with the subtitle, "The Softening and Clarification of Hard and Dirty Waters." While treating the subject from the British viewpoint, it is a desirable book to have, particularly as it seems to be the only one on water softening printed in the English language. A quite recent French book, reviewed favorably in this Supplement for April 16, 1903, is A. Taveau's "Epuration des Eaux D'Alimentation de Chaudières et Désincrustants" (Paris, no date, but doubtless 1903; 90 cts.). To those who read French this little volume can be heartily commended, but of course it, like the book by Collet, is somewhat limited in its usefulness to Americans, because it is based chiefly on the practice of another country.

As for standard works on boiler construction and steam engineering, there is hardly a branch of engineering on which so many books have been written, though most of them are now out of print. The leading works on boiler construction which can be readily obtained are Robert H. Thurston's "Manual of Steam Boilers" (New York; $5); Walter B. Snow's "Steam Boiler Practice" (New York, 1899; $3); Cecil H. Peabody and Edward F. Miller's "Steam Boilers" (New York; $4); Leslie S. Robertson's "Water Tube Boilers," a British book of which there is an American edition (New York, 1901; $3). For a general work on steam engineering, Thurston's "Manual of the Steam Engine" (New York, 1891; 2 vols., $10, or separately, $6) is perhaps as satisfactory as any. The first volume of the last-named work is devoted to "History, Structure and Theory," and the second to "Design, Construction and Operation."—Ed.)

## How to Distinguish Common Forest Trees.

Sir: Can you tell me where I can get a book giving a good description of our most common forest trees, one describing their external appearance as they stand, such as leaf, bark, etc., and giving the distinction between trees belonging to the same family, as—to tell the white oak from the red. Sincerely yours,

Jos. J. Reamer.

Waterloo, N. Y., Sept. 22, 1903.

(There are a number of books from which such information can be obtained, but perhaps the most recent and valuable and at the same time interesting, is Harriet L. Keeler's "Our Native Trees and How to Identify Them" (New York, 1900; $2). It is fully illustrated from both photographs and drawings, and describes in detail the bark, wood, winter buds, leaves, flowers, and fruit of American trees "indigenous to the region extending from the Atlantic Ocean to the Rocky Mountains and from Canada to the northern boundaries of the southern states," besides a few "naturalized foreign trees." The book also contains general historical and descriptive matter relating to species and varieties. A book of narrower scope and more popular character, containing many handsome and useful illustrations, is Annie Oakes Huntington's "Studies of Trees in Winter" (Boston, 1902; $2). Particularly useful to the engineer, but with fewer trees listed and fewer external features described than in Keeler, is Professor Chas. H. Snow's "Principal Species of Wood" (New York, 1903; $3.50), reviewed in this Supplement for May 14, 1903, and also described briefly elsewhere in this number, in the review of Professor Boulger's "Wood."—Ed.)

(Continued on p. 52.)

## The Elasticity and Resistance of the Materials of Engineering.

Reviewed by Edgar Marburg,* M. Am. Soc. C. E.

THE ELASTICITY AND RESISTANCE OF THE MATERIALS OF ENGINEERING.—By Wm. H. Burr, M. Am. Soc. C. E., M. Inst. C. E., Professor of Civil Engineering in Columbia University. Sixth Edition, Rewritten and Enlarged. New York: John Wiley & Sons. Cloth; 6 × 9 ins.; pp. 990 + 80 pp. of appended tables and plates of structural steel shapes. $7.50.

In the preparation of a "revised and rewritten" edition of this excellent book, the author has rendered a signal service at once to the practicing engineer and to the engineering student. During the twenty years that have elapsed since this work appeared in its first edition, there have been few notable contributions to the theoretic side of the subject. On its experimental side, however, the bounds of knowledge have been rapidly extended. The search for that elusive yet indispensable link between theory and practice—the empiric constant—has been carried on zealously and unremittingly, with rich returns. It may, indeed, be doubted whether in any of the older branches of engineering progress has been more marked than in that one which concerns itself with the investigation of the physical properties of the materials of construction. Laboratories for purposes of scientific or commercial testing have sprung up on every hand; apparatus and methods have been perfected and are being rapidly standardized; and the literature from innumerable sources in every civilized country has grown to such prodigious volume that the busy practicing engineer finds it difficult to keep abreast with the times in even the particular range of subjects in which he happens to be especially interested.

The most striking change during the period under consideration is to be found, however, in the materials themselves. Excepting the strictly natural products, such as timber and stone, the common materials of construction have nearly all undergone a more or less complete transformation, so that the older test-records are for the most part of little more than historic interest to-day. Steel has supplanted wrought iron for nearly all engineering purposes, and is supplied in a variety of special grades to meet particular requirements. The manufacture of cast steel, malleable iron, alloys, cement, brick and other materials has been so improved as to yield what are virtually new products. The peculiar merits of that composite material known as reinforced concrete or concrete-steel have come to be recognized only within recent years.

It is evident, therefore, that in no class of engineering treatises is the need of frequent and radical revision more imperative than in those dealing with the materials of construction. The wealth of data is, however, so great that a treatment of the subject, at once comprehensive and exhaustive, within the covers of a single book is obviously impossible. The author has necessarily to content himself with a more or less fragmentary digest of some of the best and latest data available, and with the vast accumulation of material before him, the choice is by no means an easy one.

The volume under review contains nearly a thousand pages, of which, according to the preface, one-half or more is new matter. The more advanced treatment of the theory of elasticity in amorphous bodies constituting the first hundred pages in previous editions has been relegated to the appendix. The development of that theory in a simpler form directly applicable to the conditions encountered in every-day engineering practice is presented in Part I. of the new volume, covering some two hundred pages, divided into five chapters. By the great majority of readers this change will doubtless be welcomed as one in the right direction. Briefly summarized, these chapters are devoted to the consideration of the shears and lateral strains induced by direct stresses; the relation between the coefficients of elasticity for shearing and direct stresses; the stresses in hollow cylinders, spheres and shafts; the common theory of flexure applied to simple and continuous beams and to long columns; the distribution of the internal stresses in beams; resilience in bending, shearing and torsion; and to the analysis of combined stresses, both by approximate methods and by a new and more exact method applicable to combined bending and direct stress.

The matter in these five chapters is presented in a thoroughly scholarly manner and, it is needless to add, with a clear appreciation of the practical ends it is designed to serve. The form of presentation, however, is not always as simple and direct as might be thought desirable from the standpoint of a reader approaching the subject for the first time. The notation in certain articles, especially those treating of beams under concentrated loading, is needlessly cumbersome. The theorem of three moments as here presented makes decidedly difficult reading for the beginner. The absence of a theoretical treatment of impact is noteworthy, especially in view of the increased attention lately bestowed upon impact testing, and the erroneous deductions not infrequently drawn from tests of this nature. The author disposes of this subject with the statement:

> It is important to distinguish betwen loads suddenly applied and shocks, as they are called in engineering practice. A shock is produced when the load falls freely before acting upon a piece of material sustaining it. The cause of shock, therefore, is a suddenly applied load with the effect of a free fall of the latter superimposed. These matters must be carefully taken into account and allowed for in such structures as bridges carrying rapidly moving trains, and those allowances are incorporated in the provisions of specifications covering bridge construction.

A commendable feature not existing in previous editions is to be found in a series of well-chosen problems at the close of each chapter, to the total number of 36, accompanied in part by complete solutions.

The most valuable portions of the contents, especially for reference purposes, are embraced in Part II., which constitutes much the greater portion of the volume, covering as it does some 650 pp., distributed over 14 chapters.

In the first of these chapters nearly two hundred pages are devoted to the presentation and critical discussion of data on tensile tests. This matter is admirably chosen, including in addition to some records of purely historic interest, concise summaries of recent results from the best American pactice. Thus there are nine tables of full-size eye-bar tests covering sections ranging in width from 4 to 15 ins., and accompanied in part by chemical data, the latest of these pertaining to the Monongahela River cantilever bridge at Pittsburg, now in course of construction. A valuable table is given of specimen tests of basic and acid open-hearth steel shapes and plates, with complete chemical data, on material furnished during 1899-1901 for bridges across the Harlem River, New York city, constructed under the supervision of the author. Some interesting and important data are quoted in connection with nickel steel. Twenty pages are devoted to the alloys of other metals. The article on cement and mortar contains some exceedingly valuable information of recent date, notably the summaries of averages from thousands of tests made in the laboratory of the Rapid Transit Railroad Commissioners of New York city, and in that of the Bureau of Surveys, in the Department of Public Works of Philadelphia, as well as some interesting data on long-time tests. The chapter closes with a brief consideration of the tensile strength of timbers in which the author very properly lays especial em-

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phasis on the fact that the results from small selected specimens are apt to be grossly misleading when applied to sticks of the ordinary commercial run as to size and quality.

The author's views on the theory of cold crystallization, as expressed in this chapter, will probably not receive endorsement at this day in many quarters, viz:

> There seems to be little doubt that in some, or possibly many cases the metal in wrought-iron railroad axles has been crystallized in use by rapid rotation under stresses, probably far above the elastic limit, induced by shocks resulting from unevenness of tracks or other causes.

The writer knows of no trustworthy evidence in support of these conclusions, and considers it regrettable that this statement, unfortified as it is by new evidence, should have been added in the present edition, even with the author's qualification that "probably granulation has frequently been mistaken for crystallization." The writer is fully in accord with the commonly accepted view that such crystalline fractures point either to imperfections originally inherent in the material, or that they are attributable to the method under which failure was brought about.

The succeeding chapter is devoted to the subject of compression in "short blocks," and although condensed within the narrow compass of sixty pages, the material has been selected with nice discrimination from numerous sources. The data on the compressive strength of concrete are especially satisfactory.

The next chapter, on "long columns," begins with some twenty pages of algebraic formulas relating to the moments of inertia and radii of gyration of solid and built sections. From a practical standpoint this matter is of little interest or utility. These values for the standard rolled shapes, computed with greater accuracy than implied in these formulas—that is to say, with due regard to fillets—are tabulated in all manufacturers' handbooks. In the writer's judgment, a series of modern examples of symmetrical and unsymmetrical built sections, solved by the aid of such tables, might have been substituted to advantage for the matter in question.

The remaining eighty pages of this chapter include the derivation of the Rankine-Gordon-Tredgold formula for long columns, commonly known as the Gordon formula; data from experiments on specimen and full-size columns of wrought iron, steel, cast iron and timber; the derivation of "constants" from these tests for the Gordon and the modern straight-line formulas; and the design of pin-end steel columns. The experimental data are admirably presented in both tabular and diagrammatic form. The records for steel are confined to Christie's tests on angle struts of Bessemer steel, owing to the deplorable fact that an adequate series of tests on built metal columns of modern material, workmanship and design has never yet been undertaken.

The most valuable new feature in this chapter is undoubtedly to be found in the summary and critical discussion of the full-size tests on hollow cast-iron columns made at Phoenixville, Pa., in 1896-97, under the auspices of the Department of Buildings of New York city. It is shown that for the not uncommon length-diameter ratio of 10 or 12 to 1, the ordinary formula frequently employed in practice yields results too great by about 100%, and that the strength of medium steel columns, in the light of Christie's tests, is 40 to 50% greater than that of cast-iron ones of like length-diameter ratios. These conclusions based on "cold facts" deserve to be ineffaceably impressed on the minds of that portion of the architectural fraternity which still clings with a lingering fondness to the use of cast-iron columns in building construction, on the utterly mistaken ground of superior economy. The lesson in this instance might have been enforced even more effectively had the author directed attention also to the remarkable weakness revealed in these experiments through eccentric loading on the brackets.

The parts of the volume covered in the foregoing rapid review comprise the most interesting and important portions of its contents with one notable exception, namely, the new chapter on concrete-steel members, which may be regarded as the most conspicuously excellent feature of the book. Within the space of some fifty pages the author gives here, in masterly form, a complete up-to-date résumé of this important subject, both in its theoretical and practical aspect. A critical consideration of the physical features of concrete-steel combinations in beams is followed by the analytical treatment of the rate at which the steel reinforcement acquires stress; the derivation of formulas for determining the position of the neutral axis and the value of the resisting moment, both by the application of the common theory of flexure and by assuming the intensity of stress to vary as ordinates to a parabolic curve; and to the determination of the division of loading between the concrete and steel. This matter is fully rounded out by a liberal citation of practical data from the experiments of Thacher, Hatt and various European investigators, and the application of the formulas is finally illustrated by the complete solution of several typical problems.

The limitations of space preclude a detailed review of the remaining contents, which include chapters on shearing and torsion; bending; rolled and cast flanged beams; riveted and pin connections; plate girders; ropes and chain cables; working stresses and safety factors; fatigue of metals; flow of solids, as well as a chapter on miscellaneous topics.

Of the innumerable scientific researches on the part of European investigators the author takes scant notice. This may be partly explained on the ground that the book treats neither of the appliances nor of the methods of testing; but confines itself in the main to records of experimental results, their scientific interpretation, and their practical application. For American readers the greatest interest naturally attaches to determinations on native products, which differ more or less in their physical properties from those of foreign origin.

The value of the treatise for text-book use might be distinctly enhanced, in the opinion of the writer, without attendant increase of bulk, by the omission of certain matter coming directly within the province of bridge designing, and the substitution in its stead of material relating to testing machines, testing apparatus in general, and to the methods of testing. The parts referred to are Chaps. XIII., XIV. and XVII., dealing, respectively, with riveted and pin connections; the design of a plate girder; and bridge specifications, covering an aggregate of a hundred pages; as well as the addendum of eighty pages of tables and plates from the Cambria Steel Co.'s hand-book. This and other similar publications are now supplied to engineering students at nominal prices, and in far more convenient form for ready-reference purposes. Besides, the excerpts given are by no means sufficiently comprehensive to dispense with the use of such hand-books in connection with the usual courses in structural designing.

However opinions may differ as to this and other points, there can be but one verdict as to the general excellence of the book. Its appearance in a truly "revised and rewritten" edition—new in substance as well as dress—is distinctly an occasion for congratulation to the engineering profession and to its accomplished author. The book is eminently deserving of a conspicuous place in every engineering library.

## Plain Directions for the Care of a House.

**CARE OF THE HOUSE.—A Volume of Suggestions to Householders, Housekeepers, Landlords, Tenants, Trustees and Others for the Economical and Efficient Care of Dwelling Houses. By T. M. Clark. New York: The Macmillan Co. Cloth; 5 × 7½ ins.; pp. 284. $1.50 net.**

Rarely does one see a book so eminently practical and universally useful as this. Besides including simple directions for the care of all parts of a house, much information is given regarding the structure itself and its equipment. The main subjects treated are the roof, chimneys and fireplaces, heating in its various forms, plumbing, gas and electric fixtures, and the care of woodwork. The closing chapter is on the general subject of "Keeping a House in Repair." The free use of sketches of details adds greatly to the clearness of the text.

The only adverse criticism which we have to offer, after reading the book with care, relates to what the author says about providing a water pan in hot-air furnaces in order to supply moisture to the air that has been dried by heating. The author says:

> . . . many physiologists now believe that a dry, warm air, if pure, and moderately heated, as is generally the case where it is supplied through modern furnaces, is more favorable to health in winter than an atmosphere which is warm and moist, and that people who live in houses where no attempt is made to supply artificial moisture to the air in winter are less likely to take cold than those who have the pores of the skin, while they are in the house, kept open by an atmosphere intentionally moistened. Experience seems to have confirmed this view, and very few modern furnaces have any provision for evaporating water in the air-chamber.

Had the author stated that most evaporating pans are too small, and that large and small ones are too generally neglected to be of any material value in ameliorating the desert-like dryness of the furnace-heated house, we should not have been at all surprised, but we did not suppose that any physiologists of good standing had concluded that ample evaporation did more harm than good, nor that such omission of water pans as is now practiced, be it general or rare, was based on disinterested scientific opinion. The physiological objection to the dry air from furnaces, we had supposed, was largely based on the shock to the respiratory tract due to the sudden changes from the dry, hot air of the ordinary furnace-heated house to the relatively moist and cold air of outdoors, while there has seemed to be much force in the belief that such hot, dry furnace air was in itself injurious. We do not say that Mr. Clark may not be right, but we should like the names of some of the "many physiologists" upon whom his theory is partly based.

An interesting practical point made by the author is that owners of country estates, particularly in the eastern part of this country, can reduce their repair bills by taking advantage of the fact that Italian laborers "are almost universally tolerably accomplished masons." Many of our readers have doubtless noted this fact, and some have taken advantage of it in engineering work. Mr. Clark continues:

> As farm buildings in their own country, even to the pigsties, are always of stone, they are accustomed from childhood to the use of a trowel, and the Italian traditions of bonding the stones or bricks, and of laying each piece in a bed of mortar prepared for it, are admirable.

In closing, we wish to commend the book to all responsible for the care of houses, whether as owners, agents, or renters. Any one of the thirteen chapters contains hints that might save such persons the price of the book many times over.

**FRICTION AND LUBRICATION.—A Handbook for Engineers, Mechanics, Superintendents and Managers. By William M. Davis, Member of National Association of Stationary Engineers; Engineers Society of Western Pennsylvania, etc. Pittsburg: The Lubrication Publishing Co. Cloth; 6 × 8 ins.; pp. 225; illustrated. $2.**

There is abundant need of a good treatise on lubrication. In the design of almost any machine a question which is continually recurring is what proportion must be given to the parts in order that the machine may run cool, and what provision for lubrication should be made. We shall have to say at the outset that this book will be a disappointment to the draftsman or designer who consults it for accurate and reliable data for proportioning journals and bearings. In the chapter on lubrication of railway rolling stock it is stated that driving-axle journals are proportioned for a maximum load of 175 to 200 lbs. per sq. in. of projected area and that the rate of journal surface travel on a fast passenger engine will often exceed 600 ft. per minute; but this is the only example of such figures that we find. A work on friction and lubrication which should show actual proportions successfully adopted for the journals in a great variety of machinery would be of very great value; but such a book is yet to be written.

The work before us is better adapted to the needs of the man who runs the machine than the man who builds it. The author describes the lubrication of air compressors, gas engines, marine

engines, refrigerating machines, textile machinery, rolling mill machinery, flour mills, hydraulic elevators, etc., and gives in each case practical directions which will be of use to those in charge of such machines. There are also chapters devoted to the testing of oils and to lubricating appliances, ball and roller bearings and belts, oil-house methods, etc.

In the chapter on lubricating appliances familiar American methods alone are included. No mention is made of the common European plan of forced-feed lubrication with sight-feed control. On p. 140, a cut of a patent mine car wheel is described twice, an evidence of careless proofreading that is rather disturbing. There is a fair chapter on air-compressor lubrication, but the author, while he says that very little oil is required, fails to give the caution that too much oil is likely to cause disastrous explosions.

The best chapter in the book is that on oil-house methods, records and tools. This gives information which we have never before seen in print, and which should be useful to any superintendent of a large establishment desiring to introduce systematic methods of handling oil supplies.

## The Metallography of Iron and Steel.

Reviewed by Wm. R. Webster,* M. Am. Soc. M. E.

IRON AND STEEL AND OTHER ALLOYS.—By Henry Marion Howe, Professor of Metallurgy in Columbia University in the City of New York. Boston: Sauveur & Whiting. Cloth; 6 × 9 ins.; pp. 440; tables, diagrams and photographs. $5.

The purpose of this work cannot be more clearly stated than in the preface by the author:

The heterogeneousness of this book is due to its being intended for several different though related classes of readers. It was undertaken originally for the use of my students, to supplement the instruction given by lectures and by other books. This it aimed to do by elaborating certain important matters which are not treated at sufficient length if at all in other text-books, and are not well suited to lecture-room exposition. Of these students there are at least three distinct classes; those who are to study metallurgy very superficially, the students in chemistry and civil, electrical and mechanical engineering; those who are to study it more thoroughly, the students in metallurgy and mining engineering; and those whose work is to go still farther, the advanced students.

But the very fact of writing a book fitted for these classes was an opportunity to go a little farther and meet the needs of practitioners, by giving them a systematic account of the condition of the metallography of iron to-day, and more particularly to expose to them the present or solution theory of that metallography. This seemed very important, both because this theory for the first time permits us to take a comprehensive and consistent view of the whole subject, and because for the majority of English-speaking practitioners an account is needed at once more elementary and fuller than any which is now accessible to them.

These different classes of readers bring to the subject very different kinds of preparation; and it is this difference in preparation which has led me to vary the treatment, so as to fit each part to the supposed needs of the particular class, or more often classes, of readers to which it seemed likely to be useful.

The metallography of iron and steel, in its present state, is very hard for the engineer to follow, but it has been so clearly defined in this work that the importance of this method of investigating the structure is made apparent to all.

Sixty-four pages are given to the heat-treatment of steel and cast iron. The whole subject is treated in such a manner as to be of the greatest service to the student, engineer and manufacturer, and the author gives an introduction to this subject well worth quoting:

THE HEAT-TREATMENT OF STEEL, PROCESSES OPERATING CHIEFLY THROUGH CONTROL OF THE STRUCTURE.

IMPORTANCE TO THE ENGINEER.—This subject of the structure of steel, its relation to the properties of the metal and to the thermal and mechanical treatment which it has undergone, is probably of much more direct practical importance to the young engineer than any other subject considered in this work. Its importance may be made clearer by means of an example. May its patness atone for its homeliness.

You cannot make a bad beefsteak good by the cooking; you can cook it better or worse, and it will be a worse or a less bad beefsteak, but always bad. On the other hand, you can easily spoil a good beefsteak by bad cooking. Now, just as cooking is to food so is heat-treatment to steel. Indeed, a pedantic cook might reasonably call cooking heat-treatment. Bad steel, steel of bad chemical composition, cannot be made good by heat-treatment; we can give it different degrees of badness, but we cannot cure that badness. On the other hand, we can easily make good steel bad.

In one case as in the other the excellence or the defects of the treatment can in large part be recognized by simple external symptoms.

In cooking, its effects, and its symptoms are of immediate importance to the housewife, because they are under her control through her employees. In exactly the same way and for pretty much the same reasons heat-treatment, and its symptoms, the structure of the metal, are of great importance to the practicing engineer, not only because it influences the properties of his metal very greatly, but especially because the heat-treatment itself is often given by his own employees, his smiths and his other workmen; and, moreover, because the symptoms of that heat-treatment are open to those employees, and, best of all, to himself.

Here the simile ceases to hold good, because whereas a burnt beefsteak cannot be made good, an overheated piece of steel can be restored nearly to its best condition.

Thus, the structure of steel, whether as revealed by the microscope or in the fracture of the metal, is an index, not only to the properties of the metal, but to a certain extent also to the treatment, especially the heat-treatment which it has undergone, and of the further heat-treatment which is necessary to cure any injury which has already been caused.

Numerous examples are given which show that too much importance cannot be given to the heat-treatment of steel, as on it depends, to a great extent, the strength of our structures; for good steel, chemically, is made dangerous by improper heat-treatment.

A chapter is devoted to the progress in manufacture of iron and steel between the years 1880 and 1900. It treats of nickel steel, chrome steel, tungsten steel, etc., and of deep carburizing by the Harvey and Krupp processes. Also of the extraction of iron from its ores, conversion into wrought iron and steel, mechanical treatment, statistics, cost of manufacture and increase of production.

All the subjects treated are brought up to date, and there are numerous references to the work of other investigators along the same lines. The book is well illustrated and fully indexed. It is a valuable addition to Professor Howe's "Metallurgy of Steel."

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## The Commercial Woods of the World.

WOOD.—A Manual of the Natural History and Industrial Applications of the Timbers of Commerce. By G. S. Boulger, Professor of Botany and Lecturer on Forestry in the City of London College. London: Edward Arnold. New York: Longmans, Green & Co. Cloth; 5 × 8 ins.; pp. 369; 4 plates and 66 figures in the text. $2.60 net.

This handy, useful volume is divided into two parts; the first treating of wood in general, while the second is a geographical and descriptive dictionary of the commercial woods of the world. Part I. opens with a freely illustrated account of the origin. structure and development of wood, and the recognition and classification of the different woods. Next come defects, selection, seasoning, storage, durability and uses of woods and a brief review of the wood supplies of the world. In twelve pages on "Testing Wood," density, fuel value, and strength are discussed, and a few formulas and statistics are given.

Hundreds of varieties of wood are described in alphabetical order in the 207 pages of Part II. The common apple tree may serve as an example of many of the simpler descriptions:

**APPLE** (Pyrus Málus L.: Order *Rosaceæ*). *German* "Apfelbaum," *French* "pommier," *Spanish* "manzana," *Russian* "jablon."

Height seldom over 30 ft. or diameter over 2½ ft. Dark brown, generally strongly tinted with red. Sap-wood, dull white. Rings distinct, broad, often over 1½ ins. across, with no pith-flecks; medullary rays not visible to the naked eye; vessels small, uniformly distributed, 1—4 together. Heavy, very hard, close-grained, brittle, taking a high polish, but working badly on drying. Used for mallets, tool-handles, and other turnery, and traditionally preferred in Cornwall for "poling" tin ore.

Common names are used for the catchwords throughout, and cross-references are freely employed. A few photo-micrographs are employed to show transverse sections.

The book bears evidence of frequent reference to American authorities and contains a brief bibliography. It is a different and more satisfactory book than the translation of Paul Charpentier's "Timber," reviewed in this Supplement for Jan. 15, 1903, which was described by its sub-title as "a comprehensive study of wood in all its aspects," but contained comparatively little information on the several kinds of wood. The book under review is also quite different from Prof. Chas. H. Snow's "Principle Species of Wood," reviewed in this Supplement for May 14, 1903. The latter work contained very little general matter, and described but few woods, compared with Professor Boulger's work. Professor Snow classified his woods, instead of using the alphabetical arrangement, and gave some of the leading features of the parts of the tree other than its wood. He also included in his book numerous views of entire trees, of a small portion of the bark, thus giving detail, of the leaves and fruit, and of the longitudinal section of the tree, showing its grain. Professor Snow also gave more statistics, for the woods which he described, showing the results of tests of the various woods than does Professor Boulger. The two books might well be used together, and it is a pity that we have not more like them. Manifestly, such books might be very useful to many engineers and contractors, while they would certainly interest most men in either class.

## A British Text-Book on Water Supply.

WATER SUPPLY.—A Students' Handbook on the Conditions Governing the Selection of Sources and the Distribution of Water. By Reginald E. Middleton, M. Inst. C. E., M. Inst. M. E. London: Charles Griffin & Co. Philadelphia: J. B. Lippincott Co. Cloth; 6 × 9 ins.; pp. 168; four plates and 66 figures in the text. $3 net.

Making allowances for the differences between British and American practice, this seems to be a satisfactory elementary discussion of the principles of public water supply. The author makes no pretence to originality, but does claim that in producing a small, compact work he is filling the need of many of his countrymen not yet ready for the "more technical, highly priced treatises."

The various divisions of water supply are taken up, mostly in their natural order, including quality, quantity, storage, dams, purification, service reservoirs, the flow of water through pipes, distribution systems, and pumping machinery. Mathematical formulas are generally used in a limited way where most expected, except in the brief chapter on pumping machinery.

Perhaps the author lays unwarranted stress upon the multiplication of disease germs in relatively pure water, but he is unquestionably right in teaching that they will live longer there than when in fierce competition with other bacteria. It is interesting to note that in a land where water consumption, judged by American standards, is very low, Mr. Middleton should be able to state that he has known of cases where the waste has equalled 66% of the supply.

The term catchment area is used with propriety, and watershed is properly limited to the line "separating the valley from which the supply is to be drawn from adjacent valleys." Writing of puddle walls, the author says:

It is sometimes recommended that the men treading the puddle should not wear any covering on their feet, as with bare feet they can better detect any stones, twigs, etc., which may find their way into the trench.

Few American engineers or contractors would care to ask their men to tread puddle with or without shoes. For the main embankment watering, "while being trodden over and over by horses," is commended, but "steam rolling answers very well, and is probably better than anything else, so long as the roller will work."

Under coverings for service reservoirs no mention is made of groined arches, the prevailing roof in Great Britain appearing to be some simple form of arch supported on girders resting on either masonry piers or cast iron columns. Cast iron columns are also used "in many instances" to support high elevated water tanks. In a paragraph on stand-pipes these are described as pipes "rising to the necessary height in the form of an inverted V," which is much unlike the huge stand-pipes used in hundreds, if not thousands, of American cities and towns.

The word meter does not appear in the index,

but under the heading "Prevention of Waste" the district system of waste meters is briefly described.

The foregoing outline and citations will serve to show the general character of the book and some of the most interesting differences between water supply practice in two of the leading countries of the world.

## Electrical Machinery Mathematically Considered.

A TEXT-BOOK OF ELECTRICAL MACHINERY.—Vol. I. Electric, Magnetic, and Electrostatic Circuits. By Harris J. Ryan M. Am. Inst. E. E., M. Am. Soc. M. E., Professor of Electrical Engineering, Cornell University; Henry H. Norris Assoc. M. Am. Inst E. E., Assistant Professor of Electrical Engineering, Cornell University, and George L. Hoxie, Assoc. M. Inst E. E., Jun. M. Am. Soc M. E. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 × 9 ins.; pp. 258; tables and 134 figures in the text. $2.50.

This work is specifically a students' text-book. The classification and arrangement of the subject matter, the method of attack, and the style of the work, all suggest distinctly the pedagogical viewpoint. Thus, the first sentence of the book reads, "Electrical phenomena are manifestations of molecular action."

The complete work is intended to discuss all forms of electrical machinery from a single point of view; to this end alternating currents and their properties are discussed first, so that the entire first volume is taken up with fixing the mathematical preliminaries to the actual study of machines. Moreover, the work begins at a fairly advanced point. The student must be acquainted with the nature of electric and magnetic action (and hence with the distinctive phenomena of electricity and magnetism) and must have a clear conception of the meaning of the various conventional terms used, for example: Electric current, magnetic flux, and quantity of electricity.

The method of treatment adopted by the authors departs radically from the beaten path in electrical instruction. The central feature of the method (we refer now only to Vol. I., which is preparatory to the study of the machines themselves in Vol. II.; the latter volume is not yet issued) is that the discussion bases on the alternating current as the typical manifestation of electricity, and for this reason considers magnetic flux, electric pressure, current, etc., as quantities which vary according to the sine law, or approximately so. In order to make due allowance for alternating wave-forms not sinusoidal, an extended analysis is presented of the properties of sine curves and the resolution of non-sine waves into component sine-waves of different frequency. On this basis, certain phenomena of elementary importance in electrical engineering are described and investigated. These are: The effects of resistance, inductance and capacity in simple and complex circuits; the power consumption of circuits; magnetization and hysteresis; skin effect; eddy-currents; dielectric hysteresis and leakage current; the production of rotating magnetic fields; and lastly, electrostatic leakage through gases, that is, corona effects. It will be seen, that the subjects considered are selected with special reference to modern high-pressure alternating-current working.

Going over the book somewhat more in detail: The first chapter is a brief introductory statement of the methods of producing electric pressure and of the density and tension of magnetic flux. The hydraulic analogy is employed to help explain magnetic flux, although in general this chapter seems to presuppose a substantial conception of electric and magnetic conditions. The second chapter defines the magnetic and electric units, with little or no subsidiary explanation. The next chapter gives matter not often found in electrical text-books; it deduces the principal properties of sine curves, such as area, average value, effective value, and sums and products of non-coincident sine curves, and then illustrates how irregular alternating values may be resolved into sine components. Two or three pages on vectors and complex algebraic quantities are followed by a discussion of the relation between potential and current in circuits having resistance, inductance, or capacity, or several of these properties. The following chapter discusses the power of alternating currents, with either sine or non-sine waves. The laws of the electric circuit being thus made clear, the magnetic circuit is considered. Naturally, the magnetic qualities of iron, its changing permeability for magnetic flux, the effect of heat treatment and working on the permeability, and finally the hysteretic lag of iron, occupy this chapter. (It is rather interesting to note that Ewing's theory of magnetization is introduced here; this and the use of the water analogy in the first chapter seem curiously out of harmony with the style of the remainder of the book.)

The following chapter treats of combined electric and magnetic circuits in one of their most important applications: the use of two or more alternating currents of different phase to produce a rotating magnetic field. These rotating fields are classified into "pivot fields" and "cylinder fields," the former of which appear to be a special case of the latter. The rotation and intensity of these rotating fields are derived mathematically, and it is shown that "cylinder fields" do not vary uniformly as long as the number of phases is small.

Phenomena of a radically different nature from those previously considered are observed in the neighborhood of high-pressure electrical conductors—brush discharges or "corona" and streamer discharges. These phenomena are discussed in connection with the electric rupture of insulators when a sufficiently high pressure, the break-down voltage, is applied. The brush discharges are explained to be nothing more than distributed rupture of the air insulation. A formula is given for the minimum safe thickness of insulators to withstand given pressures.

In the last chapter, circuit losses are discussed. The effect of resistance, inductance and capacity is studied with reference to actual conductors; that is, the values of these factors in terms of the nature of conductor and circuit are derived. In addition, the "skin effect" of increased resistance in large wires is explained; eddy-current losses in the conductors themselves as well as in conducting masses near a circuit (cores, etc.) are calculated; the loss by hysteresis in the magnets and the dielectric is referred to, and the effect of brush discharges in limiting the potential on transmission lines is shown from curves of observed losses on an experimental line. An appendix gives some additional observations on the leakage through air from transmission lines.

Illustrative problems are introduced in the book wherever possible. The problems are generally practical, and, in fact, it is apparent throughout that the authors' aim has been to adapt the treatment to the practical status of electrical science. As already implied, however, the work is by no means elementary and it is distinctively a college text-book.

THE JOURNAL OF THE IRON AND STEEL INSTITUTE.—Vol. LXIII., for the Year 1902-3. Edited by Bennett H. Brough, Secretary. London: E. & F. N. Spon. New York: Spon & Chamberlain. Cloth; 6 × 9 ins.; pp. 814; tables, plates, and figures in the text. $6.

This volume contains a notable presidential address by Mr. Andrew Carnegie, which was printed in condensed form in Engineering News of May 14, 1903. The technical papers included are as follows: Development of the Continuous Open-Hearth Process, by B. Talbot; Hollow-Pressed Axles, by C. Mercader; The Influence of Sulphur and Manganese on Steel, by J. O. Arnold and G. B. Waterhouse; The Application of the Electric Furnace in Metallurgy, by A. Keller; Portland Cement from Blast Furnace Slag, by C. de Schwartz; A New Blast Furnace Top, by A. Sahlin; The Effect of Flue Dust upon the Thermal Efficiency of Hot-Blast Stoves, by B. H. Thwaite; Note on the Alleged Cementation of Iron by Silicon, by J. E. Stead; The Open-Hearth Process, by L. Cubillo; Note on the Analysis of a Specimen of Sussex Cast Iron, by T. Turner; The Determination of the Points of Allotropic Changes of Iron and its Alloys by the Measurement of the Variations in the Electric Resistance, by O. Boudouard; The Heat Treatment of Steel under Conditions of Steel-works Practice, by A. Campion; The Influence of Varying Casting Temperature on the Properties of Alloys, by P. Longmuir.

Following these papers and the discussions of them comes the usual bibliography of the world's literature of the iron and steel industry in 1902. This practice of giving in a few words the contents of all the important articles and papers published during the current year is one that many other societies might well adopt.

## Aerial Telephone Lines.

TELEPHONY.—In Six Parts. Part IV. The Construction of Aerial Lines. By Arthur Vaughan Abbott, C. E. New York: McGraw Publishing Co. Cloth; 6 × 8 ins.; pp. 263; 143 illustrations in the text. $1.50 separately; $6 for the set.

In its general style, this volume is similar to the three preceding ones (reviewed in this Supplement for July 16). Its subject is the construction of aerial circuits for telephone systems.

As overhead lines constitute by far the largest portion of telephone lines in the world, and as they are that part of telephone systems which is exposed to the destructive influence of the elements and to the disturbing effects of other circuits, it is evident that the study of their construction is an important branch of the subject of telephony.

The first half of the present volume is a general description of practice in aerial line construction and a discussion of the conditions of design. The second half, as in the preceding volumes of this set, is put in the form of a specification for the construction work. This specification departs, however, from the usual form of specifications, in that it is largely descriptive of materials and methods and, furthermore, prescribes the preferred method for conducting the engineering or preliminary work, as well as merely the actual construction work. This second half of the book is, therefore, more properly a text on the construction of aerial lines. The first part of the book, in this light, is a discussion of some special parts of the work and of the governing external conditions. Much of it is repeated, in more or less condensed form, in the "specification." The following is a partial summary of the subjects discussed in the first half of the book:

An introductory chapter which emphasizes the importance of careful pole-line construction is followed by an explanation of distortion in long lines, and Pupin's method of loading the circuit with inductance. It is stated that this loading increases the practicable talking distance about fivefold. How the route for a pole line should be selected, and the relations between different pole lines on the same right of way, are discussed, largely with reference to "golden-rule" principles of behavior. The pole which supports the line, the cross-arms, pins, insulators, and the wire itself are next treated. The cost of overhead telephone lines is given a separate chapter, which contains a number of diagrams of cost, covering the range of the various conditions of geographical location, height and size of poles, etc.

The book is very fully illustrated, but many of the illustrations, particularly the half-tone views, are unsatisfactory.

GISEMENT'S MINERAUX; Stratographie et Composition.—Par Francois Miron. Paris: Gauthier-Villars. Paper; 4¾ × 7½ ins.; pp. 157. 75 cts.

This book relates solely to non-metallic minerals, and forms a companion volume to "Gisements Miniers," by the same author, which treats of the metallic minerals. The method of treatment is the same in both volumes. Each mineral is considered separately, and its character, origin, composition and commercial utility are briefly stated, followed by a description of the principal mining deposits and their character and importance. The treatment is very brief and general, and the volume is therefore useful only as a handy quick reference book for ascertaining such general facts as have for the moment escaped the memory.

LES MATERIAUX ARTIFICIEL.—Par Marie-Auguste Morel. Paris: Gauthier-Villars. Paper; 4¾ × 7½ ins.; pp. 176; Illustrated. 75 cts.

This volume describes briefly the character, manufacture and commercial employment of various so-called artificial products, such as bitumens and asphalts, cements and limes, metals, bricks, glass, paints and paper. The book conveys only a general knowledge of the various subjects treated.

## Graphic Statics Applied to Trusses, Beams and Arches.

Reviewed by Prof. Henry S. Jacoby.*

GRAPHIC STATICS.—With Applications to Trusses, Beams, and Arches. By Jerome Sondricker, Assistant Professor of Applied Mechanics, Massachusetts Institute of Technology. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 ins.; pp. 137; three double-page plates and 79 figures in the text. $2.

The author begins his book with a brief presentation of the principle and methods of statics for forces lying in the same plane, the construction and use of both the force polygon and the funicular or equilibrium polygon, and the graphical determination of moments.

Roof trusses are next treated, including their construction and loading, and the methods of finding their reactions and stresses. The trusses considered include simple trusses on masonry supports, and also on column supports as in mill buildings, as well as three-hinged arches with both open and solid webbing. A general method is developed for dealing with frames where stresses occur in addition to direct tension and compression, which is then applied to several examples, the most important being the frame of a mill building. The reactions for the truss and its supporting columns are found by the method of deflections, the entire treatment being very satisfactory. Considerable attention is given to counterbracing, not only in the roof trusses, but also in the longitudinal and sway bracing of buildings. It is to be regretted that the author does not use the plus sign for tension and the minus sign for compression, since this system is in far more general use in practice than the other, and it would be advantageous to have its use universal. A feature that deserves special mention consists in the numerous directions given for the construction of stress diagrams with a view to securing greater accuracy in the results. Another important feature relates to the notes whose object is to give the student a broader conception of the significance of the equilibrium polygon as well as of its wide range of application.

In the third chapter graphic methods are applied to find the shears, bending moments and deflections of simple and cantilever beams. The fourth chapter relates to masonry arches, abutments and piers, their general conditions of stability and the determination of their lines of pressure under various loadings. This chapter contains some discussion, which, on account of the unusual interest at present on the part of bridge engineers in the design of masonry arches, will be appreciated in spite of the fact that they are much too brief and indefinite. For the purpose of comparing the results of three methods based on the theory of the elastic arch, the author worked out an example in detail, by the exact solution, by an approximate solution, and according to the method proposed by Winkler, and then contented himself with recording only a few general statements and some small scale diagrams without any numerical results. The presentation and discussion of at least the more important detailed results would not only have enabled others to form an independent judgment of the comparative merits of these methods, but also to avoid the necessity of repeating the arduous labors involved in such an investigation. It must be added that it is somewhat disappointing to learn that "the author has no recommendation to make as regards the best method of locating the line of pressure of a masonry arch," after referring to the second class of methods which are more or less conventional in character. This feeling is intensified by the absence of any reference to the results of experiments on arches made in the laboratories of the Massachusetts Institute of Technology, or to the elaborate tests in Austria, which might be expected to throw some light upon which method is the best for the practical purpose of designing. It is to be hoped that in a future edition this lack may be supplied.

The importance of the solution of problems by the student in addition to the examples given in the text is recognized in every chapter, but the number of carefully selected problems might well be increased for the benefit of less experienced instructors.

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On the whole, the text gives constant evidence of the exercise of care in its composition, and of the author's experience as a teacher, making the book a useful addition to the extensive literature of graphic statics.

## Electricity on Shipboard.

DIE ELEKTROTECHNISCHEN EINRICHTUNGEN MODERNER SCHIFFE.—By O. C. Roedder, Baltimore, Md. Wiesbaden: C. W. Kreidel. Paper; 7 x 10½ ins.; pp. 346; 222 illustrations and 2 tables in the text. With bibliography and index. $2.70.

The title of this work, "The Electrical Equipment of Modern Ships," adequately describes its contents. It is a description of the types of electrical machinery and the methods of wiring, etc., used in the electric light, power and signal equipments of vessels in most advanced practice. American work is very fully represented; this is due in part to the fact that the author is connected with the U. S. Navy, but also to the fact that this country is in the front rank of progress in adapting electricity to marine purposes. For both reasons it is to be regretted that the book appears in a foreign language and from a foreign publishing house.

The text matter is, of course, mainly descriptive. General designs, details, sizes and weights of the machinery are given quite fully (in metric measure), and the leading requirements of the government specifications are given in some cases.

The motive power of the dynamos is the first thing considered. Belt-driving is practically out of use, it appears, and direct-connected vertical engine sets appear to be the rule. Steam turbines are used to some extent, at least those of the De Laval type, of which there are said to be several hundred in use on various ships. Storage batteries appear to be little used outside of submarine boats and pleasure yachts, and are but briefly considered. Wiring and fittings are an important matter, because of their complexity and the contracted spaces available for the wires. Steel-tube conduits are sometimes employed; armored lead-covered cables find extended use, being preferably hung to walls or ceilings by clamps. The methods and specifications prevalent in the various navies are explained. General systems of utilizing electric power are discussed in a separate chapter. Alternating current is little used, mainly because of the projectors, which were indeed the principal reason for the original introduction of electricity on shipboard (1870 to 1880); the alternating-current arc is, it is stated, much inferior to the direct-current arc lamp for this service. Nevertheless some vessels have been fitted throughout with polyphase machinery.

Some phases of the general arrangement of the electrical machinery on board ship are discussed in Chap. 6, and considerable historical and statistical matter about electricity in marine service is given in this connection. Various general uses of electric power on ships, such as driving vent lators, winches, boat-hoists and operating bulkhead doors are described in the next chapter. The advantages of electric service as regards weight and steam-economy are then briefly discussed. In weight alone the electric service shows no essential gain over steam operation, according to the author's figures, but a large saving in coal consumption is secured (the steam auxiliaries often consume as much as 25% of the total coal, with an average steam consumption per horsepower more than five times as high as for the main engine).

The most important item of auxiliary power service on naval vessels is the service of the guns: Supplying ammunition, rotating the turrets, training the guns, etc. Electricity has come into wide use in this work, quite a number of the naval vessels built in recent years having electric ordnance service throughout, as shown by a table given in Chap. 9. The various types of machinery used for this purpose are described quite fully, at any rate as regards the ammunition hoists and the turret-turning devices. Electric steering gear is treated in the following chapter, two main systems being described. The mechanism of electric projectors is then taken up, and following this the apparatus for internal communication and signaling within the vessel are discussed. These latter comprise call-bells, telephones and indicators of various kinds for giving a specified series of signals, as for directing the main engine, te artillery service from a central point. Rudder indicators and electric logs are also described. Of related nature is the apparatus for signaling from the vessel to some external point, which comprises mainly control mechanism for lamp and flash signals; Chap. 13 treats of these devices in detailed manner. The most modern method of signaling is given a separate chapter: Wireless telegraphy, or, as it is more accurately expressed in German, spark-telegraphy. The descriptive matter here is almost exclusively in the nature of explanatory diagrams of various systems.

REPORT OF THE MASTER CAR BUILDERS' ASSOCIATION.—Chicago: Joseph W. Taylor, Secretary, Rookery Bldg. Half leather; 6 x 9 ins.; pp. 620; illustrated.

This volume contains the full report of the proceedings of the 37th annual convention, held at Saratoga, N. Y., in June, and also contains the standards and recommended practice of the Association. These reports grow larger each year, and the present one is rendered still more bulky than usual by the insertion of a large number of folding plates, in addition to the 35 plates representing the standards and recommended practice. Some of the principal committee reports deal with tests of brake shoes and of M. C. B. couplers, steel and tank cars, the high foundation, and steam and air-line connections. Among the topical discussions we mention drop tests of car axles, journal box packing, repair shops at outlying points, four-wheel and six-wheel trucks for passenger cars, relation of the position of the third-rail to ordinary rolling stock. There is also included an address on safety appliances by Mr. E. A. Moseley, Secretary of the Interstate Commerce Commission, and a paper by Mr. Angus Sinclair, pointing out the undesirability of supporting or endorsing the proposals for the compulsory introduction of the metric system.

REPORT OF THE PROCEEDINGS OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—Chicago: J. W. Taylor, Secretary, Rookery Bldg., Chicago. Cloth; 6¾ x 9 ins.; pp. 457; illustrated.

This volume contains the proceedings of the 36th annual convention, held at Saratoga in June, 1903. The principal committee reports, with the resulting discussions, present a mass of information as to individual practice and experience in the matter of ton-mile statistics, electric power for railway shops, and various details of locomotive design, tests and practice. The following papers may be mentioned: Drawbar and Buffer Attachments between Locomotives and Tenders, by Henry Bartlett; Internal Combustion Engines in Railway Service, R. P. C. Sanderson; Light for Locomotive Headlights, and Effect of Tonnage Rating on Cost of Transportation. In addition there are discussions of the following topics: Long tubes in locomotive boilers; setting tubes in firebox tube sheets; grinding as a finish for piston rods and crank pins; weights of principal parts of locomotives too heavy to be lifted by hand, to determine the capacity of shop cranes and hoists. The illustrations include folding sheets of the standards and recommended practice of the Association.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.—Proceedings of the Annual Meeting at Aurora, Ill., Jan. 21 to 23, 1903. Chicago, Ill.: E. E. R. Tratman, Secretary and Treasurer. Paper; 6 x 9 ins.; pp. 152; tables and figures in the text. 50 cts.

This annual report contains a full account of the proceedings of the society at its eighteenth annual meeting. It also contains lists of engineers and surveyors in the State of Illinois and in the city of Chicago. There are reports of the committees on water-works, surveying, railways, etc., and papers on these and other topics. Among the papers are: Purification of Water for Small Cities, C. B. Burdick; The Absorption Test for Paving Brick, Prof. A. N. Talbot; Sewage Purification Plants for Summer Cottages, J. W. Alvord; Discharging Capacity of Brick and Pipe Sewers, Prof. A. N. Talbot; The Testing Laboratory of the Chicago, Burlington & Quincy Ry., M. H. Wickhorst; Third-Rail Electric Railways. E. E. R. Tratman; Maintenance of Earth Roads and Road Plans of Illinois, Prof I. O. Baker.

## Railroad Curves, Earthwork and Tables.

RAILROAD CURVES AND EARTHWORK.—By C. Frank Allen, M. Am. Soc. C. E., Professor of Railroad Engineering in the Massachusetts Institute of Technology. Third Edition. New York: Spon & Chamberlain. London: E. & F. N. Spon. Leather; 4 x 7 ins.; pp. 198; tables and diagrams. $2; or if bound with tables (look below), $3.

FIELD AND OFFICE TABLES.—Specially Applicable to Railroads. Author, publisher, style and size as above; pp. 293. $2; or if bound with Railroad Curves, $3.

Of the many books on railway curves, none is better adapted to class use than this new edition of Allen's "Railroad Curves and Earthwork." The subject matter is not only arranged in logical order, but the book is also written in a style so lucid that it may well serve as a model of good English.

The first hundred pages are devoted to circular, parabolic and spiral curves, which are illustrated with numerous examples, and it is here that the author's experience as a teacher shows to great advantage. To illustrate, we shall quote from p. 29, relative to the laying out of a simple curve in the field:

*Field-work* of laying out a simple curve having given the position and station of P. C. and P. T.

(a) Set the transit at P. C. (A).
(b) Set the vernier at 0.
(c) Set cross-hairs on V (or on N and reverse).
(d) Set off ½ $d_1$ (sometimes ½ D) for point 7.
(e) Measure distance $C_1$ (sometimes 100) and fix 7.
(f) Set off total deflection for point 2.
(g) Measure distance 1 — 2 = 100 and fix 2, etc.
(h) When total deflection to B is figured, see that it = ½ I, thus "checking" calculations.
(i) See that the proper calculated distance $C_2$ and the total deflection to B agree with the actual measurements on the ground, checking the field-work.
(k) Move transit to P. T. (B).
(l) Turn vernier back to 0, and beyond 0 to ½ I.
(m) Sight on A.
(n) Turn vernier to 0.
(o) Sight toward V (or reverse and sight toward P), and see that the line checks on V or P.

We have quoted these directions in full because they illustrate a principle that "practical writers" of "practical books" are prone to ignore, namely, the importance of explicitly enumerating every step required to perform a given operation in the field. Nothing should be assumed as being self-evident to a student, when it comes to field methods of surveying; and the practice of designating each act by a letter, or by a numeral, as above illustrated, is one that experience in teaching surveying has demonstrated to be the most effective for the prevention of mistakes.

Following the subject of curves are 80 pages on the staking out of earthwork and on earthwork computation.

The author's treatment of this subject is quite as commendable as his treatment of the subject of curves. There are, however, some additions that might be made to this part of the book that would not increase the number of pages greatly, but would materially assist the student. Thus, it would be well to have some illustrations showing how center stakes and slope stakes should be marked. Almost invariably the student will attempt to make the marks in a line *across* the stake instead of *lengthwise*; and he is quite likely to start the line at the bottom (near the point) of the stake and write up, whereas he should write from the top down. It is also well to mark the station on the back of those slope stakes that are marked with the cut or fill on the face. A few words on how to make the marks would also be of assistance to the beginner. The author has given practically nothing on setting stakes for culverts, abutments, etc., which might well be included. He has neglected to state that slope stakes should not ordinarily be driven before the right of way has been cleared. A form of profile level notes might well accompany the form of cross-section level notes given by the author. The author correctly says that the "averaging end areas" formula is most commonly used; and he would have done well to give some rule of taking cross-sections close enough together to ensure substantial accuracy in all cases. The author does not make the common error of assuming that the prismoidal formula is used invariably by all careful engineers. Here as elsewhere he shows familiarity with actual American practice in railway location work. In fact, there is but one chapter in this book that to us seems "theoretical;" we refer to the short chapter on "Haul." The author would do well to read a discussion on overhaul in the last volume of Proceedings of the American Railway Engineering and Maintenance of Way Association, giving special attention to Mr. Walter G. Berg's definitions of "free haul," "average haul" and "over haul."

We come now to the author's tables and diagrams for earthwork computation. The diagrams may be dismissed with a few words. The author shows two small, sample diagrams, one for a 14-ft. roadbed, the other for a 20-ft. roadbed, both having 1½ to 1 slopes; but he clearly describes the method of constructing large diagrams for three-level section work. These sample diagrams show center heights on oblique lines, sum of distances out from center on vertical lines, and cubic yards for 50-ft. sections on horizontal lines. A diagram for prismoidal corrections and another diagram for triangular prisms are also given. The author says:

In point of rapidity diagrams are much more rapid than tables for the computation of Three-Level Sections. For Triangular Prisms and for Prismoidal Correction, the diagrams are somewhat more rapid. For Level sections, the tables for Three-Level Sections are at least equally rapid.

The author's tables for earthwork computation occupy 36 pages, and each table gives the cubic yards in a prism 50 ft. long. The first of these tables gives the yardage of triangular prisms having any width in feet from 1 to 9, and any height in even tenths of a foot up to 48 ft. Thus, a 50-ft. prism having for its base a triangle with a width of 9 ft. and a height of 47.9 ft., contains 399.17 cu. yds. This table is evidently applicable to trapezoids also, and is consequently a very useful table for irregular section work.

The prismoidal correction table occupies four pages, and it gives the correction to be applied to the "end area" solidity to secure a result strictly correct by the prismoidal formula. In using this table the "arguments" are ($C_1 - C_0$) and ($D_1 - D_0$), in which $C_1$ is the center cut at one station and $C_0$ the center cut at the following station, while $D_1$ and $D_0$ are the distances between the slope stakes. The tables give $C_0 - C_1$ for every single foot from 1 to 9, and $D_0 - D_1$ up to 23.9 ft.; thus for $C_0 - C_1 = 9$, and $D_0 - D_1 = 23.9$, the correction is 66.39 cu. yds. to be subtracted from the "end area" solidity.

The table giving the yardage for three-level section work occupies 15 pages, each page being devoted to a different width of roadbed from 14 to 30 ft., inclusive, excepting for widths of 17 and 19 ft. The slope in every case is 1½ to 1, and the yardage is for prisms 50 ft. long. Each table gives, for any center height, quantities under two columns, L and K. Column L gives the yardage for a level section for every height from 0 to 29.9 ft. Column K gives a quantity to be used in connection with the side heights. The figure from column K is to be multiplied by ($h_r + h_l - 2_c$), in which $h_r$ = cut or fill at the right, $h_l$ = cut or fill at the left, and c = center cut or fill. This product is to be added algebraically to the value taken from column L.

We have gone into detail in reviewing these tables because they differ somewhat from any of those in the 12 books of earthwork tables reviewed in our issue of Jan. 15, 1903. The merits and limitations of Allen's earthwork tables can now be seen by a comparison with what we then said regarding other tables.

Besides the earthwork tables in this volume, there are tables of logarithms and tables of the different natural and logarithmic functions of the right angle triangle, etc. Table I. gives radii and their logarithms for every minute of curvature up to 9°, then for every even minute from 9 to 14°, inclusive, then for every fifth minute from 15 to 40°, inclusive.

Another table gives tangent distances for a 1° curve, corresponding to every minute up to 98°. A table is given of squares, cubes, square roots, cube roots and reciprocals of every number up to 1,019.

For the convenience of those who wish to compare the contents of this new volume with those of books already in their possession the following list of the tables is given:

Radii and their Logarithms; Tangent Offsets and Middle Ordinates; Tangent Distances for 1° Curve; Corrections for Tangent Distances; External Distances for 1° Curve; Offsets from Tangent for a 10° Curve; Angles Proportional to Squares of Distances; Long Chords and Actual Arcs; Arcs for Strip 100 Feet Wide; Curves for Metric System; Barometric Heights; Logarithms of Numbers; Logarithmic Sines, Cosines, Tangents and Cotangents; Auxiliary Tables for Logarithmic Sines and Tangents of Small Angles; Logarithmic Versed Sines and External Secants of Small Angles; Natural Sines and Cosines; Natural Tangents and Cotangents; Natural Versed Sines and External Secants; Lengths of Circular Arcs, Radius = 1; Squares, Cubes, Square Roots, Cube Roots and Reciprocals; Turnouts and Switches; Velocity Heights; Rise per Mile of Various Grades; Elevation of Outer Rail on Curves; Inches in Decimals of a Foot; Middle Ordinates for Curving Rails; Stadia Reductions, Horizontal and Vertical; Mean Refractions and Declination; Triangular Prisms, Cu. Yds. per 50 Ft.; Prismoidal Correction, Cu. Yds. per 100 Ft.; Cubic Spiral Easement Curves; Numbers and Formulas; Explanation of Each Table.

In these 280 pages of tables, which may be had in a separate volume, it will be seen that the author has apparently omitted no table likely to be used by the locating engineer, and he has included several that are not often used.

While the author has entered a field already well covered by several excellent books, he has produced a work that is quite certain to hold its own in the struggle for existence.

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MODERN PRACTICAL ELECTRICITY.—A Popular and Practical Treatise on the Applications of Electricity in Modern Life. By R. Mullineux Walmsley, Principal and Head of the Electrical Engineering Department of the Northampton Institute, London. Vols. I. to III., to be followed by Vol. IV. Chicago: W. T. Keener Co. Cloth; 7½ x 10 ins.; pp. 888; 12 plates and 876 figures in the text.

The sub-title of this work, "A Popular and Practical Treatise on the Applications of Electricity in Modern Life," is a good and sufficient characterization of its contents. The ground seems to be covered quite completely, and in a simple, easily comprehensible style. The method of development is the historical and physical one; successive conceptions, as of the phenomena of static electricity, magnets, electric currents, and lastly, the relative interaction between magnetism and current electricity, are presented as they were actually gleaned from successive scientific observations. The work is in two parts: The first, entitled "The History and Principles of Electrical Science," extends to the middle of the third volume. The remainder of this volume, and the as yet unpublished fourth volume, deal more specifically with the description of practical, i. e., commercial, appliances and methods. It is in two divisions, the one discussing power machinery (The Generation, Transmission and Utilization of Electric Power), while the other treats of telephone, telegraph signal and other appliances (Practical Appliances of Small Electric Currents).

The work is very fully illustrated, and the drawings and views, which appear to have been carefully selected, are well suited to the purpose of supplementing the text. It may be added that no mathematical work or calculation looking toward design is introduced; simple mathematics is introduced at a few points to better define fundamental physical relations.

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THE MISSISSIPPI RIVER BRIDGES are the subject of a paper by Mr. F. B. Maltby, U. S. Assistant Engineer, in the August number of the "Journal of the Western Society of Engineers," and the paper gives an historical and descriptive account of each of the several bridges. Beginning with the Hennepin Ave. bridge in Minneapolis, and ending with the bridge at Memphis, there are no less than 48 bridges, and it is interesting to note that 16 (or one-third of the entire number) are in and between Minneapolis and St. Paul. Of the total number, 24 are railway bridges (including two pontoon bridges), 18 are highway bridges, and 6 are for both railway and highway traffic. The combination bridges include three with double decks and three with a single deck. Most of the bridges are of truss construction, but there is a stone arch bridge, and three steel arch bridges.

## A Directory of Wealth.

THE FINANCIAL RED BOOK OF AMERICA.—1903. A Directory of the Wealthy People of the United States. New York: The Financial Directory Association. Cloth; 7⅛ x 10 ins.; pp. 388. $10.

This book contains a list of the men and women of the United States who are believed to have wealth amounting to $300,000 or more. It is cheerful to record that their number—if we may believe the preface of the volume, we haven't counted them—is above 15,000. These names are arranged geographically, each state by itself, and the cities and towns in each state rejoicing in the possession of one or more $300,000 man, arranged alphabetically.

A good many questions suggest themselves to one who looks over this book. In the first place, it is a pretty difficult matter for any man of wealth to determine how much—or how little—he is worth. If his property is invested in bonds and stocks quoted on the exchanges, he can on any given date, by taking the market price of his securities, make a fair estimate of their value; but such an estimate holds good only for a day—or, if exactness is desired, only for an hour. It is not only possible but probable that a great many people whose names appear in this book reached the $300,000 standard a year ago, but would fall so far below it now that they really have no right to a place in its pages, and ought to be cast out to join the rest of the impecunious unfortunates on the outside.

Nor is the case any different if wealth is invested in real estate, or in mercantile or industrial enterprises. Such property, like stocks and bonds, is worth what it can be sold for; and it is a very hard matter to determine with any approach to accuracy how much such property would bring, for the circumstances of the sale make a great difference with the price.

Bearing in mind these difficulties in gaging any man's wealth, even from inside sources, it will be of interest to see how the compilers of this volume went to work. From a statement furnished us, we quote as follows:

> In the beginning, the co-operation of prominent bankers and financial authorities, business men, assessors, public officials and other well-informed persons was secured to make proper lists of names from their respective localities. In the large cities, special agents were employed to compile lists in consultation and co-operation with bank presidents and other financial authorities. The original lists, as fast as completed were submitted for correction and emendation, under the direction of the office editorial staff, not only to the original compilers, but also to local authorities, particularly newspaper editors, and to many others who have special sources of information in regard to such matters. The names thus obtained were further verified and corrected by a large staff of office editors and compilers, using local directories of various kinds, county, real estate and Probate Court records and other documentary sources of information. Finally, after the names were in type, proofs were submitted first to those who had supplied the lists and then to others in the different localities, and finally each name personally was sent to the individual represented for approval or correction.

From such vague and far-off knowledge of the $300,000 class as we may humbly claim, we are inclined to believe that the work has been pretty well done—better considerably than in the average published trade directory. The errors we judge to be chiefly errors of omission, and so far as any are aggrieved by being excluded from this golden circle, we doubt not that by making a suitable "show-down" of their wordly goods to the compilers of the work they may readily gain admission to the next edition.

Curiosity will naturally be aroused as to where the purchasers for this work will be found. Of course, it goes without saying that a copy will form part of the stock in trade of every promoter of financial enterprises, and it will be extensively used also, we presume, by the sellers of such articles of luxury as find their chief purchasers among the very rich. Possibly, in some sections it may prove serviceable as an up-to-date substitute for the discarded "elite directory," and a handy manual for use in preparing for social functions and revising calling lists.

One interesting feature of the book is that in most cases the occupation of the parties named is given, as well as their business and residental addresses. It is notable that the great proportion of the names in the book are of men engaged in active business. Excluding the names of women, the proportion of men who lay claim to no occupation whatever other than the indefinite one of "capitalist" is very small. One Connecticut man, indeed, is set down as a "Gentleman of Leisure; Possessor of Inherited Wealth;" but while this description would doubtless apply to many other people here encountered, it is clearly still better form in these United States to lay some claim to the pursuit of a gainful occupation.

## Reports on Railway Topics.

REPORT ON NEW SOUTH WALES GOVERNMENT RAILWAYS AND TRAMWAYS.—Sydney, New South Wales: The Railway Commissioners. Paper; 8¼ x 13 ins.; pp. 53; maps and diagrams.

This is the annual report for the year ending June 30, 1903. It contains traffic statistics and particulars of improvements in construction and equipment, together with diagrams showing the expenses, earnings, etc., from 1888 to 1903.

INDEX TO PAPERS AND SUBJECTS DISCUSSED BY RAILWAY CLUBS; May 31, 1902, to May 31, 1903.—Published by the Society of Railway Club Secretaries: J. W. Taylor, Western Railway Club, Chicago; or H. D. Vought, Central Railway Club, New York. Paper; 3¼ x 5¾ ins.; pp. 16.

This handy and useful little reference pamphlet gives the dates of meetings of twelve railway clubs for the years 1902-1903, with the titles of papers or subjects discussed at each meeting.

STATISTICS OF RAILWAYS IN THE UNITED STATES.—Report of the Statistician to the Interstate Commerce Commission. Washington, D. C.: Pub. Doc. Cloth; 6 x 9 ins.; pp. 701.

This fifteenth annual report is for the year ending June 30, 1902, and contains the complete statistics, a summary of which was issued as a preliminary report some months ago. The first 127 pages are occupied by the report proper, with tabulated summaries of statistics. The remainder of the book is composed of a series of tables giving the details of operation, finance, etc., for each individual railway in the United States, numbering about 2,037.

TRUE VALUE OF OHIO RAILWAYS FOR PURPOSES OF TAXATION.—Report by Prof. Edward W. Bemis and Carl H. Nau, Public Accountant. Prepared at the Request of Hon. Tom L. Johnson, Mayor of Cleveland, and With His Approval as to Results. Cleveland, O.: Any of the above-named. Paper; 6 x 9 ins.; pp. 20; tables.

According to this report, owners of farms and of city real estate pay more than twice as much taxes on the actual value of their property as do the railways. The report shows how this is brought about, gives some detailed figures for 14 typical Ohio railways, and some figures by counties showing what each of the latter loses in railway taxes. The figures are based on the assessments of 1902.

RESOURCES OF THE COUNTRY BETWEEN QUEBEC AND WINNIPEG. Along the Line of the Grand Trunk Pacific Ry.—Compiled by H. M. Ami, of the Geological Survey Department of Canada: Ottawa, Ont.: Pub. Document. Paper; 6½ x 9¾ ins.; pp. 179, with map.

This government report contains a brief and summarized account of the topographical conditions, agricultural and mineral resources, etc., of the country traversed by that part of the proposed national transcontinental railway lying between Quebec and Winnipeg. The information is compiled from numerous reports of surveys and explorations made in this region by government and other engineers from 1843 to 1903. The general result is to show that the country is suitable for agricultural development, has mineral, timber and other resources, and affords a suitable and favorable route for the railway. Many of the individual reports are quoted very fully, and the book is interestingly descriptive of a region which is as yet little known except by hunters, surveyors and prospectors.

Those interested in the movement for improved methods of municipal accounting will welcome the appendix to the July number of the Monthly Bulletin of the Statistics Department of the city of Boston, consisting of an exhibit of the receipts and expenditures of that city for the fiscal year 1902-3, grouped according to the "uniform system" of the National Municipal League. The work has been done under the direction of Dr. Edward M. Hartwell, Secretary of the Statistics Department of Boston, and President of the committee of the above-named League having this important subject in charge. Boston, it is a pleasure to add, is only one of several cities to the finances of which this system has been applied, either in a yearly summary, or for the whole scheme of accounting. The most essential features of the system are also being applied to Ohio municipalities, under a new department of the government of that State, and with Mr. Harvey S. Chase, of Boston, as expert adviser. Mr. Chase is also a member of the committee above named.

## Public Health Reports.

MICHIGAN HEALTH OFFICIALS.—Sixth General Conference, Held at Ann Arbor, Jan. 15 and 16, 1903. Lansing, Mich.: State Board of Health. Paper; 6 x 9 ins.; pp. 98; illustrated.

A striking title and a most significant paper in this volume is "Pneumonia—The New Captain of the Men of Death," by Dr. Arthur R. Reynolds, Commissioner of Health of Chicago. It contains the following:

> Since the census year 1900, pneumonia has claimed more than one-eighth of all the victims of the Grisly Reaper in Chicago, one-third more than consumption, and 44% more than all the other contagious and infectious diseases combined. . . . . 4,489, as compared with a total of 6,560 from pneumonia.

The report also contains papers on mosquitos and malaria, water pollution, and the Michigan State Laboratory of Hygiene.

STATE BOARD OF HEALTH OF RHODE ISLAND.—Report for 1899, with Births, Marriages and Deaths in 1898. Gardner T. Swarts, M. D., Secretary. Providence, R. I.: Pub. Doc. Cloth; 6 x 9 ins.; pp. 205 + 312; tables, diagrams and folding plate.

Aside from routine matter and vital statistics, this report contains some analyses of water from public supplies, and a description of the mechanical filter plant at East Providence, R. I., written by Dr. Swarts in 1899. It may be added that we find no explanation in the volume of the reason for delaying the publication of reports for the years 1899 and 1898, respectively, until the latter part of 1903, but of course this delay may not have been the fault of the State Board of Health.

SANITARY CODE OF THE CITY OF NEW YORK.—E. J. Lederle, Ph. D., President of the Board of Health. New York: Pub. Doc. Leather; 4 x 6 ins.; pp. 100.

We here have in convenient form the health ordinances of the city of New York, as consolidated and amended to July, 1903. Among the many subjects covered are the local regulations concerning plumbing and ventilation.

GEOGRAPHIC TABLES AND FORMULAS.—By Samuel S. Gannett. Bulletin No. 214, U. S. Geological Survey. Washington, D. C.: Pub. Doc. Paper; 6 x 9 ins.; pp. 284; illustrated.

In this volume an endeavor has been made to bring together all tables and formulas used by the topographers of the Geological Survey in their field work. The material has been compiled from various sources, and it comprises some 28 large tables and a number of smaller tables and statements of formulas. The titles of the 28 large tables are as follows:

> Polaris; times of culmination and elongation. Polaris; azimuth at elongation. Polaris; azimuths and altitudes at different hour angles. Projections for large areas. Projections; scale $1/_{125000}$, latitudes 0° to 80°. Projections; scale $1/_{62500}$, latitudes 0° to 80°. Projections; scale $1/_{62500}$, latitudes 25° to 50°. Projections; scale $1/_{48000}$, latitudes 26° to 50°. Areas of quadrilaterals; 30′ extent, latitudes 0° to 90°. Areas of quadrilaterals; 15′ extent, latitudes 0° to 90°. Areas of quadrilaterals; 10′ extent, latitudes 0° to 90°. For conversion of arc into time. For conversion of time into arc. For conversion of mean time into sidereal time. For conversion of sidereal time into mean time. For interconversion of feet and decimals of a mile. For conversion of wheel revolutions into decimals of a mile. Five-place logarithms of natural numbers. Five-place logarithms of circular functions expressed in arc and time. Geodetic position computations. Log. m, for use in computing spherical excess. Mean refraction. Corrections for curvature and refraction. For obtaining differences of altitude. Horizontal distances and elevations from stadia readings. For converting metric into United States measures. For converting United States measures into metric. For interconversion of miles and logarithms of meters.

## Records and Discussion of Rainfall and Run-Off in the United States.

WATER SUPPLY AND IRRIGATION PAPERS OF THE U. S. GEOLOGICAL SURVEY.—Chas. D. Walcott, Director; F. H. Newell, Hydrographer in Charge. Washington: Pub. Doc. Paper; 6 × 9 ins.
No. 80: The Relation of Rainfall to Run-off. By Geo. W. Rafter. Pp. 104; 15 tables and 23 figures in the text.
No. 81: California Hydrography. By Joseph Barlow Lippincott. Pp. 488; many tables, 4 figures in the text and 1 map.
Nos. 82, 83 and 84: Progress of Stream Measurements for the Calendar Year 1902. By F. H. Newell. No. 82, North Atlantic Coast and St. Lawrence River Drainage; pp. 199; many tables. No. 83, Southern Atlantic, Eastern Gulf, Eastern Mississippi River and Great Lakes Drainage; pp. 304; 7 figures and many tables. No. 84, Western Mississippi and Western Gulf Drainage; pp. 200; 2 figures and many tables.

This is certainly one of the most unique and valuable set of papers ever issued from Washington. Descending from the general to the particular or local, we have Mr. Rafter's study of "Relation of Rainfall to Run-off," Mr. Newell's progress report on Stream "Measurements" in 1902, covering nearly the whole United States for one year, and Mr. Lippincott's summary of the available records of rainfall, evaporation and run-off in California.

In general, Mr. Newell's papers follow the line of the records of stream flow and allied topics for previous years. A fourth paper will soon appear relating to the Far West, thus completing the statistics for the United States. This work of the U.S. Geological Survey is of constantly increasing value to engineers, besides contributing in other ways to the welfare of the whole country.

As such records accumulate the need for consolidating the figures scattered through various reports becomes imperative. This need has been met for the State of California by Mr. Lippincott in Paper No. 81, which brings together in one volume "as much of the data concerning the water supply of California as is available from printed records, observations of other engineers, and investigations made by this Survey." The papers contain a number of observations on evaporation, a large mass of stream discharge figures, some weir tables, and rainfall tables. For convenience, the latter have been rearranged from calendar to seasonal years.

Mr. Rafter has addressed himself to the broad and, all things considered, difficult problem of the "Relation of Rainfall to Run-off." His study embraces the most reliable of the available records for the whole country and a review of the most important literature of the subject. Rainfall, run-off, evaporation, ground water flow, and the relation of forests, topography and geological structure to run-off are each considered in as much detail as the space will permit, and references to sources are given. Formulas and general diagrams for run-off are presented and discussed, and there are many diagrams showing the relation between precipitation, evaporation, run-off and temperature for various streams. There are also tables giving rainfall, run-off and evaporation for many streams for the storage, growing (crops) and replenishing periods of series of years, and a consolidated table showing for 12 streams the mean or average rainfall, run-off and evaporation for storage, growing and replenishing periods. These averages are for periods ranging from 8 to 38 years.

A summary with 43 heads and occupying about three pages presents the author's conclusions in convenient form. Some of these conclusions, as well as the discussion on which they are based, will be disappointing to those who expect to find in this monograph a definite and final answer to all questions bearing upon the relation of rainfall to run-off. Thus, the first sentence of the first conclusion reads: "There is no general expression giving accurately the relation of rainfall to run-off." Not all the conclusions are of this character, and where the author's conclusions are, so to speak, inconclusive, or where they tend to upset preconceived notions, the reason therefor is generally nothing more or less than a lack of reliable data. In fact, the whole study is an eloquent indirect plea for further and more reliable observations. Nevertheless, the monograph contains much of a sufficiently positive character to be of direct aid in run-off calculations, while its summary tables and diagrams are instructive, convenient and useful.

## Two British Mechanical Engineers' Pocket-Books.

THE MECHANICAL ENGINEER'S POCKET-BOOK.—By the late D. Kinnear Clarke, M. Inst. C. E.; Fifth Edition; Revised Throughout and Enlarged by H. H. P. Powles, M. Inst. M. E., Assoc. M. Inst. C. E. New York: D. Van Nostrand Co. Leather; 4 × 6 ins.; pp. 692; tables and figures in the text. $3.

Compared with the last preceding edition, the book has been enlarged forty pages. This, however, is not a correct measure of matter that has been added, since many portions of the old text have been replaced by new, without any increase in the space occupied. Among the new additions those of greatest bulk are made to the sections on electrical engineering. The book as a whole is decidedly improved by the new matter, and beyond this statement nothing is needed to acquaint owners of earlier editions with the contents of this last edition. To others it may be said that the volume is without doubt the best British handbook on mechanical engineering, and as giving British practice is a worthy companion volume to the American pocket-book of Kent.

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MECHANICAL ENGINEER'S POCKET-BOOK, 1904.—Edited by William H. Fowler, M. Inst. C. E., M. Inst. Mech. E. Manchester, England: Scientific Publishing Co. Leatherette; 4 × 6 ins.; pp. 441; tables and figures in the text. $1.

To American engineers at least this book is less well known than the mechanical engineers' pocket-book of D. K. Clarke, and it hardly appears likely to replace the latter book in American popularity. The reasons for this is that it is even more purely British than Clarke in the character of its contents, and is much more limited in scope. In its advantage, however, there should be mentioned its extremely low price, which makes it available to many who feel unable to pay the price of a Kent or a Clarke. As a dollar book the volume is good value, and for British practitioners should serve a useful purpose. It may be added that this is a revised edition, and that it appears to be the practice of the publishers to bring out a new edition frequently, if not yearly, thus affording an opportunity for frequent revision. The large number of advertisements and the "buyers' directory" account, at least partly, for the low price of the book.

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AMERICAN PUBLIC HEALTH ASSOCIATION.—Papers and Reports Presented at the Thirtieth Annual Meeting, New Orleans, La., Dec. 9 to 12, 1902. Columbus, O.: Dr. Charles O. Probst, Secretary. Cloth; 7 × 10 ins.; pp. 582 + LVIII.; tables, plates and diagrams. $5.

As is fitting on the part of an organization in the interests of the public health, the Proceedings of this association contain a number of reports and papers on engineering and closely allied subjects. In the present volume the report of Mr. Rudolph Hering, M. Am. Soc. C. E., Chairman of the Committee on Disposal of Refuse Materials, is followed by papers on refuse disposal at Montreal, Providence, Buffalo (by Prof. O. H. Landreth, M. Am. Soc. C. E.); Cincinnati, New York city (by Geo. A. Soper, Assoc. M. Am. Soc. C. E.); and Vera Cruz, Mex. Some of these papers include reviews of the experience and practice in the cities considered. Other committee reports that may be mentioned here are those on disinfection and disinfectants, and standard methods of water analysis (Geo. W. Fuller, Assoc. M. Am. Soc. C. E., Chairman). Prof. W. T. Sedgwick and C. E. A. Winslow contributed a paper "On the Relative Importance of Public Water Supplies and Other Factors in the Causation of Typhoid Fever." A unique paper on "Air Testing in Tunnel Construction," by Joseph W. Ellms, of Cincinnati, describes tests for imflammable and explosive gases in the air from headings of the new water-works tunnel at Cincinnati.

Other papers and reports deal with car sanitation, vital statistics, various phases of the control of communicable diseases, and bacterial problems.

In view of the enormous pressure for shelf room in both public and private libraries it would seem desirable to use a thinner paper for these Proceedings. The present volume is 2½ ins. thick and yet has a total of only six hundred pages. On the other hand, the paper is light for its bulk and is unglazed, both good features.

## Wireless Telegraphy.

WIRELESS TELEGRAPHY.—Its Origins, Development, Inventions, and Apparatus. By Charles Henry Sewall. New York: D. Van Nostrand Co. Cloth; 6 × 9 ins.; pp. 229; 85 illustrations, including a few plates. $2 net.

The history of wireless telegraphy, as it may be written to-day, must look for its material mainly to newspaper clippings, patent claims, and inventors' assertions and recriminations. In the present very obscure state of the art the proper sifting, arranging and valuing the work which has been put upon the subject could be accomplished only with the aid of deeper knowledge of the mysteries of wireless telegraphy than yet exists, plus a transcendent genius for recognizing the core of truth in involved speculative expressions. The author, as far as we know, does not pretend to the possession of either this knowledge or that genius, and the work which he has compiled gives no stronger indication in that direction. It is in large part an abstracted record of patent claims, often quite crudely put together; this is prefaced by a short narrative record of the principal known achievements in transmitting telegraphic signals without wires. An appendix gives a reprint of certain American patents issued, respectively, to Dolbear, Lodge, Marconi and Tesla. There is no mathematical or other analysis in the book, and it is written in a quite simple style.

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AMERICAN WATER-WORKS ASSOCIATION.—Proceedings of the Annual Convention Held at Detroit, Mich., June 23 to 26, 1903. Elmira, N. Y.: John M. Diven, Secretary. Paper; 6 × 9 ins.; pp. 724; folding plates and illustrations in the text.

The number and character of the papers in this issue, the amount of discussion, and the general make-up of the Preceedings show the effect of the new spirit which has been infused into the association in the last few years. To suggest one or two further improvements we may note that much time of the convention, and no little typesetting and good white paper could be saved by adopting a new method of choosing the meeting places of the association. The discussion on that subject in the present volume occupies about 25 pages. This and some of the other discussion might at least have been materially cut down before publication. A further saving in bulk might be effected by using a little smaller type and leading less heavily, but the advisability of this course is perhaps open to question. Certainly the contrast between the present easily-read page and the small close-spaced type of a few years ago is very pleasing.

The contents of the volume were fully indicated, and the papers and discussion abstracted in the report of the convention which appeared in Engineering News of July 2, which date leads us to remark that the Proceedings have again been published with remarkable promptness. A wide range of topics was presented at the convention. Nearly a hundred pages of the report are devoted to papers and discussion on private fire services for factories and other buildings. Depreciation, electrolysis, water purification, fire protection, meters and meter location, water waste, pipe specifications and necessary volume of water supply are some of the other topics presented at more or less length.

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AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Proceedings of the Rochester Convention of 1902. Brooklyn, N. Y.: Geo. W. Tillson, Secretary. Paper; 6 × 9 ins.; pp. 205; illustrations in the text. $1.

For a technical society having only one meeting a year and a comparatively small membership this organization has published a remarkably good series of Proceedings. Some of the earlier volumes may have been rather overbalanced by matter on pavements. While the present one contains a goodly amount of matter on that subject, in it may also be found much valuable information in the shape of committee reports and papers on garbage and street cleaning, sewerage and sewage treatment, water-works, paving, electric lighting and municipal franchises. There is a series of papers on the various public works of Rochester. The report of the Committee on Uniformity in Municipal Accounting and National Statistics contains schedules for making up uniform statistics on water-works, street construction and sewers, all as adopted by the society in 1902.

## Pneumatic Power Transmission.

COMPRESSED AIR.—A Treatise on the Theory and Practice of Pneumatic Power Transmission. By William Charles Popplewell, Assoc. M. Inst. C. E. Manchester, England: The Scientific Publishing Co. Cloth; 6 × 9 ins.; pp. 284; 118 figures in the text. $3.

In the first chapter of this book its author elucidates the general principles of the pneumatic transmission of power more clearly and concisely than any other book on the subject with which we are familiar. For the experienced user of compressed air this chapter will perhaps appear to be over-elementary, but it will not be found so by the student and general practitioner, and it is for them that the volume is primarily intended. In this chapter only general statements are made; no quantitative results are arrived at or alluded to. This omission is remedied by a succeeding chapter on compressed air calculations and another on efficiency tests of compressed air machinery. These three chapters are the most valuable parts of the book, and contain matter of permanent technical value and utility. They are plainly written and the reader who thoroughly masters their contents will have a good working theoretical knowledge of compressed air generation, transmission and application.

Aside from the chapters just mentioned, the contents of the book are purely descriptive in character. Air compressors are first described. A short section is first devoted to water piston and hydraulic compressors and wet compressors using metallic pistons. Dry compressors are then given a large amount of space. Several makes of machines are described, and, with the exception of the Westinghouse air pump, the Ingersoll compressor and the air-controlled rotary valve compressor of the Philadelphia Engineering Works, these are all British and Continental makes. To the American reader this full account of the principal compressors of foreign manufacture is particularly welcome, since American books have very little information to furnish regarding foreign practice in compressor construction.

The following chapter describes a number of air motors, including motors for compressed air locomotives and tram cars. Several chapters describing appliances and tools worked by compressed air follow the chapter on motors. One chapter relates to hoists, riveters, drills, punches, etc.; another describes and illustrates the various forms of Boyer hammers, and a third describes various forms of pneumatic pumping appliances. A very practical chapter on pipes and accessories used in the transmission of power by compressed air closes the descriptive part of the book. In conclusion, the author gives a brief chapter of discussion on the general subjects, economy of pneumatic power transmission, objections to the use of compressed air, precautions to be taken in using compressed air, etc.

The book is indexed and generally well made typographically and mechanically, except for the over use of trade catalogue cuts, which are in some cases of rather poor quality.

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CATALOGUE AND INDEX OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY, from 1901 to 1903.—Bulletin No. 215. Washington, D. C.: U. S. Geological Survey. Paper; 6 × 9 ins.; pp. 234.

The title of this catalogue is sufficiently indicative of the contents, but it may be well to add that it includes the atlas sheets and geologic folios published during the past two years. This catalogue and index supplements Bulletin No. 177, published in 1901, the two forming an index of the publications of the Geological Survey from 1879 to the present time.

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THE POLYTECHNIC ENGINEER.—Brooklyn, N. Y.: The Engineering Society of the Polytechnic Institute of Brooklyn. Cloth; 7 × 10 ins.; pp. 114; tables and figures in the text.

This student publication is made up mostly of brief papers by members of the class of 1903. It also contains some papers by former students, and one on "Progress in Locomotive Construction and Operation Since 1873," by Magnus C. Thiseng, Professor of Mechanical Engineering at the Institute.


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## Testing Dynamos and Motors.

THE PRACTICAL TESTING OF DYNAMOS AND MOTORS.—By Charles F. Smith, Assoc. M. Inst. C. E., Assoc. M. Inst. E. E. Manchester, England: The Scientific Publishing Co. Cloth; 6 x 9 ins; pp. 231; 82 figures in the text. $2.

There is no better way to learn all about electrical machinery than to actually work with it and study its behavior in detail under various conditions. The dynamo laboratories of electrical engineering colleges are established for this very reason, to put the student next to the actual machine, let him find out how to get the various desired results from it, and note the secondary results produced—the drop in voltage as the load increases, the heating of the coils, etc. The present book furnishes a guide for such laboratory study, as far as the direct-current dynamo and motor are concerned. It is not a handbook for shop testing or for conducting acceptance tests, though the exposition of experiments and methods of testing which it contains covers this ground also. Primarily, it is, as the author styles it, "an elementary introduction to the study of continuous-current machinery." It is elementary in the sense that it does not extend to calculation or design of machines; where possible the results are summarized in curves instead of being handled by mathematics.

The book comprises instructions for making a series of experiments and tests on dynamos and motors, discussions of the results obtained from the experiments, and sufficient general explanation to round out the work from a laboratory note-book to a practical test on direct-current machines. A brief summary of its contents will indicate what ground the book covers.

The subject is introduced by a series of suggestions and cautions relative to experimenting, suggestions such as: Draw a complete diagram of connections before beginning the experiment; keep a calibration curve for each instrument; do not neglect the lubrication of the bearings or the adjustment of the brushes. The first tests described are those for determining armature and field resistances; the potentiometer and Thomson bridge methods are included, among others, and it is shown how the temperature of the coils may be found from measurements of the increase of resistance. The manner in which electromotive force is generated in a dynamo is then briefly summarized, and an experiment given to determine the voltage-speed curve for a separately-excited machine. The strength of magnetization as a factor in generated voltage is next considered, and this leads to obtaining magnetization curves by voltage tests with varying field current. Armature reaction is explained in some detail in the next chapter, to make clear the importance of the characteristic curves of machines, and to show how the exciting current must vary to give constant voltage. These special matters are discussed in the form of tests. With this as a basis, the shunt, series and compound dynamo are successively taken up, in separate chapters; the tests described are in each case interspersed with explanatory matter and discussion of curves obtained. Direct-current motors are similarly treated in another chapter. Efficiency tests are then discussed, first for motors (brake tests) and then for dynamos, by various methods, including the operation of machines in circuit, determination of losses, testing of engine-dynamo sets, etc. Chapter XII., entitled Miscellaneous Tests, discusses tests of insulation, magnetic leakage and variation of voltage around the commutator. The last chapter treats of boosters and balancers and gives tests for studying their effect.

THE ARCHITECT'S DIRECTORY AND SPECIFICATION INDEX FOR 1903-4.—New York: William T. Comstock. Cloth; 7 x 10 ins.; pp. 134. $2.

Besides a directory of the architects of the United States and Canada, this volume includes the names and addresses of many manufacturers and dealers in building materials and appliances, classified by trade subjects; also a list of architectural schools and officers of the various architectural societies. Where possible, membership in architectural societies has been noted after the names of the architects.

DRAINAGE MODIFICATIONS IN SOUTHEASTERN OHIO AND ADJACENT PARTS OF WEST VIRGINIA AND KENTUCKY.—By W. G. Tight. Washington: U. S. Geological Survey. Paper; 9 x 12 ins.; pp. 111; 17 folding and other plates, including topographical maps, and one figure in the text.

After some introductory matter this volume reviews the characteristics of the present river valleys and of the old high-level valleys. A number of special descriptions of valleys are then given, after which the reconstruction of the old drainage systems and topographic features are discussed and the old and the present river systems are compared. There is a section on the relation of existing streams to their valley floors and to deposits within the valleys. The numerous handsome half-tones were reproduced from photographs by the author.


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## Planning High-Speed Electric Railways.

NOTES ON ELECTRIC RAILWAY ECONOMICS AND PRELIMINARY ENGINEERING.—By W. C. Gotshall, M. Am. Soc. C. E., M. Am. Inst. E. E., President and Chief Engineer New York & Portchester R. R. Co. New York: McGraw Publishing Co. Cloth; 6 x 9 ins.; pp. 251; plates and figures in the text. $2.

The proper procedure in planning a suburban, or rather an interurban, electric railway, is the central theme of this work. Interwoven with the discussion of this subject, however, is a large amount of matter on constructional details, amounting to an exposition of preferred design and construction for the case of high-speed electric railways. The discussion of the "preliminary engineering," or planning, for the construction of such roads is rounded out by two brief chapters on the supervision of the construction work and the organization of the operating department. Appended to the main part of the work is a reprint of the specifications prepared by the author for the New York & Port Chester R. R., a projected 25-mile four-track line, designed to run between New York city and the state line separating New York and Connecticut.

About half the book is concerned directly with the engineering work required to determine the commercial advisability of a given project for an electric railway. Considerable use is made, as an illustration, of the development of the New York & Port Chester R. R. project, which was carried out by the author, together with Mr. C. O. Mailloux. The principal motive of this part of the book is a strong insistence on the necessity for most thorough investigation of probable traffic, earning power, and probable cost of operation, in connection with the usual reconnoissance lines. The best methods for making such investigations are explained, and full illustration of the results obtainable is given by figures relating to various roads.

The second or design portion of the book deals successively with roadway and track (including a short discussion of the relative value of third-rail and overhead-trolley current supply), power station and substations (with some notes on the use of storage batteries), and rolling stock. This latter subject gives occasion for a good discussion of the most advanced method of determining required motor capacity.

It is almost needless to say that direct-current power supply, with alternating-current distribution from a central power station, is assumed throughout the work. Nevertheless, the author repeatedly directs attention to the possibility of the advent of a successful single-phase alternating current motor in the near future, and insists that this possibility must be constantly borne in mind in the design of high-speed electric roads. Even more strongly does he maintain that the design shall allow for interchange with steam roads; that is to say, with the present-day main line railways. Freight or express service is not directly considered by the author, probably for the reason that this branch of electric railway operation is as yet almost entirely undeveloped.

The book is an elaboration of a series of lectures delivered by the author at Lehigh University during the past year. It is quite fully illustrated by diagrams and tables, and bears every evidence of being thoroughly modern and practical.

## A Maintenance-of-Way Pocket-Book for Indian Railways.

THE PERMANENT-WAY POCKET-BOOK AND RAILWAY MAN'S COMPANION.—By T. W. Jones, Assistant Engineer, East Indian Ry. Second Edition; Revised and Enlarged by R. Young. Calcutta, India: Thacker, Spink & Co. Cloth, oblong; 6½ x 4 ins.; pp. 187; illustrated. Price, 4 rupees, 6 shillings, or $2.40.

The first edition of this pocket-book was published in 1902, and the present edition has been enlarged by the addition of some new matter while its scope has been extended a little beyond that of maintenance-of-way work. As India has some 27,000 miles of railway it should afford a field for this book, but outside of that country it would have but a limited amount of usefulness, since conditions and customs differ in so many respects from those of other countries. Thus, it deals mainly with railways having gages of 5 ft. 6 ins. and 3 ft. 3⅜ ins., while prices are given in Indian currency. In earthwork, also, bullock carts, coolies and female laborers are among the factors for estimating.

The laying out of curves is first discussed, various formulas being given, and it is recommended that the widening of gage on curves should not exceed 1 in. for a gage of 4 ft. 8½ ins. or 5 ft. 6 ins, while the superelevation should not exceed 5½ ins. In regard to wooden ties, it seems to be taken for granted that they will be bored for the spikes, the augers used being ⅛-in. smaller than the spike in hard wood, or two-thirds the diameter of the spike in soft wood. The merits of metal ties are not discussed, as those ties are so extensively used in India that they are taken as a matter of course. As opponents of metal ties in this country usually declare that such ties cannot be properly tamped, it is of interest to quote the following:

> Metal sleepers cannot, as a rule, be packed so firmly as wooden sleepers when first laid, but by going over them carefully three or four times until they are well bedded, they can soon be put right, and they then require less attention than wooden sleepers.

About 40 pages (not arranged consecutively) are devoted to frog and switch work, and there is a series of instructions and rules concerning maintenance work, with lists of items and weights of track material. Then come 15 pages of "standard dimensions" for Indian railways of broad and narrow gage, covering roadbed, track, stations, water tanks, ashpits, motive power and rolling stock equipment, etc. Under the head of gage of foreign railways, Canada is credited only with 5 ft. 6 ins. and 3 ft. 6 ins., although probably 99% of the mileage has a gage of 4 ft. 8 ins. Tables and formulas for bridge and roof work are followed by notes on electricity, and on electric, steam and hydraulic power.

The arrangement is not very systematic, and brevity is of course one of the principal features of the style. The illustrations are mainly frog and turnout diagrams, with a few views of track tools.


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A correspondent in East Cleveland, O., writes:

"Sir: Having had occasion recently to calculate the weights of several prismoidal figures, whose dimensions were expressed in feet, inches and fractions of an inch, I found that the use of "Smoley's Tables" greatly facilitated the work. Thinking that the method might be of interest to many readers of Engineering News, I hereby submit it.

In Smoley's tables we have the logarithms and squares (the latter given in feet and decimals of a foot) of quantities expressed in feet, inches and fractions of an inch, varying by thirty-seconds of an inch. To use these tables in calculating the weight of a prismoidal figure, let the weight of the prism be called $x^3$, the three dimensions of the prism, a, b and c, and let H equal the weight of a cubic foot of the substance.

Then the required weight is equal to

$$x^3 = a\,b\,c\,H,$$

and

$$\log a + \log b + \log c + \log H = 2 \log x;$$

or,

$$\tfrac{1}{3}(\log a + \log b + \log c + \log H) = \log x. \quad (1)$$

Since the tables give the second power of the root parallel with its logarithm, we can read $x^2$ direct from its logarithm, which is the weight sought. . . . .

In conclusion, permit me to say, that I think the engineering and architectural professions are greatly indebted to Engineering News for its publication of "Smoley's Tables," as their advent has reduced the drudgery of the calculations of framed structures by fully one-half, and the writer hopes that his modest suggestions may tend to reduce tedious work along other lines."

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In addition to a general revision, extensive changes have been made in Part III on Storage-dams, both of masonry and of loose-rock, rock-fill dams of California, and arched and combined masonry and metal dams in the West. The chapters on subsurface water sources and on rain-fall and run-off of streams have been much extended and brought up to date.

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## The Ohio River Considered as an Historic American Highway.

WATERWAYS OF WESTWARD EXPANSION.—The Ohio River and Its Tributaries. By Archer Butler Hulbert. Vol. 9, Historic Highways of America. Cleveland, O.: The Arthur H. Clark Co. Cloth; 5 × 8 ins.; pp. 220; 3 folding maps. Complete in 16 vols., in sets only. $39 net.

The plan of this series of monographs is to tell a portion of the history of America by a portrayal of the "evolution of its highways of War, Commerce and Social Expansion." Beginning with the paths of the indians and of the buffalos, the series continues with Washington's, Braddock's, Forbes's and Boone's roads, the portage paths, the military roads of the Mississippi Basin, historic waterways (the present volume) and the Cumberland road. Pioneer roads and great canals are to have two volumes each. The series will close with "The Future of Road Making in America" and an index. Thus far eight volumes have appeared, the one on military roads having been postponed.

In the announcement of the series there was included a volume on "Historic Waterways," but the present volume, which bears the same number, is confined to the Ohio and its tributaries, except as some voyages on the Ohio, here described, are continued down the Mississippi to New Orleans. This limitation to a single river, important as that river is, to the exclusion of the Hudson, Lakes George and Champlain, the Great Lakes, and the Mississippi, to name no other historic waterways, suggests that the original scheme of the series proved too ambitious for a single author, as well it might. The Far West and with it the railways seem to have been left out of account, but there are to be two volumes on canals. If canals, why not railways?

Our present concern, however, is chiefly with the volume on the Ohio and its tributaries. Extracts from the Preface will partly answer some of the questions previously raised.

In the study of Waterways of Westward Expansion, the Ohio River—the "Gateway of the West"—occupies such a commanding position that it must be considered most important and most typical. Such is its situation in our geography and history that it is entitled to a most prominent place among Historic Highways of America which greatly influenced the early westward extension of the borders and the people of the United States. Not until a late period in the expansion era—the day of steam navigation—did the Great Lakes rise to importance as highways of immigration, and south of the Ohio River Basin there was no westward waterway of importance. The day of the keelboat and barge was of moment in the broadening of the American sphere of influence on this continent, and nowhere is the study of these ancient craft made to so good advantage as on the Ohio and its tributaries.

This monograph is devoted, therefore, to the part played by this waterway as a road into the West.

. . . . . .

It is hardly necessary to point out to any reader of these volumes that the Ohio River was the highway upon which all of the great early continental routes focused. Washington's Road, Braddock's Road, Forbes's Road, and Boone's Road—like the Indian and buffalo trails they followed—had their goal on the shores of this strategic waterway. The westward movement was by river valleys (a fact perhaps never sufficiently emphasized) and not until the Tennessee, Monongahela, Kanawha, and Kentucky Rivers were reached were any waters found to run parallel with the social movement itself.

When this goal of half a century was reached, then followed a half century of river travel that is being forgotten with remarkable rapidity.

After informing his readers as to the range of latitude and longitude covered by the drainage area of the Ohio River, and that the river has a drainage area of 214,000 sq. miles, the author gives some other figures well designed to impress or confuse the ordinary reader. He says:

In 1868, 1,342,005,725,800 cu. ft. of water passed Pittsburg, and in 1869, 1,634,846,499,200 cu. ft. At the same time the anual downfall of rain in the entire Ohio drainage was twenty and one-half trillion cubic feet, while the discharge of the Ohio into the Mississippi at Cairo was five trillion cubic feet. The ratio of discharge to downfall therefore was 0.24.

Why figures for 1868 and 1869 were chosen we are not informed, but the object of stating the run-off and rainfall of the Ohio River is explained as follows:

These estimates, which undoubtedly approximate the truth, are of moment to our study. Nature cast, with a lavish hand, her waters where they would count tremendously in the opening of this continent; for the waters that fell here flowed into the West and the social movement was to be westward. The Ohio, more than any river, was to influence the flood-tides of immigration.

The origin of the name Ohio having been discussed, the balance of the first chapter is used to give an interesting account of the "first glimpse of the Ohio River," as recorded by Monsieur Céloron de Bienville and his party in their trip down the river in the summer of 1749 to claim the surrounding country for France. Next there is a chapter on incursions beyond the Ohio, to "The Indian Side," and the schemes both small and great for opening up the vast territory there awaiting development. The remainder of the book describes the Allegheny, Monongahela and Ohio River, as recorded at the opening of the nineteenth century in a river hand-book called "The Navigator;" the evolution of the river craft, from canoes and keel-boats to steamboats; the picturesque river men of three generations; and the improvement of the river for purposes of navigation. The river craft and the river men afford ample opportunity for interesting descriptions, many of which are given. As to the improvement of navigation, the author opens his chapter on that subject by stating that in the 32 years from 1806 to 1838 the U. S. government expended $6,823,560 on the Cumberland Road, while in the 75 years from 1827 to 1902 only $6,752,042 "was appropriated for the Ohio River and much of that was portioned out to the Mississippi, Missouri and Arkansas."

While an examination of this volume, and of the outline of the series of which it forms a part, gives an impression of sketchiness, yet both the volume and the series have the merit and interest of a fresh method of approach, and one of particular interest to engineers—the relation of great highways to the development of a country.

## Reports on the Civil Operations of the United States in Cuba.

CIVIL REPORT OF BRIGADIER-GENERAL WOOD, Military Governor of Cuba, 1901.—Washington, D. C.: Pub. Doc. Paper; 6 × 9 ins.; Vols. IV. to XV., not paged consecutively; numerous tables and plates. Do., Jan. 1, to May 20, 1902. Vols. I. to VI.; do.; do.

These volumes include the reports made by various departments of the government conducted by General Wood in Cuba, accompanied by a vast mass of statistics, many diagrams, maps, and reproduction of half-tones. Most of the volumes deal with the departments of customs, public instruction, justice, agriculture and the like. Some of the separate reports of most interest to the readers of this Supplement may be noted more particularly, as follows:

### REPORT FOR 1901.

A large volume is devoted to Sanitation, being the report of Major W. C. Gorgas, Chief Sanitary Officer. Among other interesting topics in this report is an account of the mosquito extermination work carried on as a part of the wonderfully successful campaign against yellow fever in Havana and elsewhere.

The report of Maj. H. F. Hodges, Chief Engineer of the Department of Cuba, also fills a whole volume. Harbor works, surveys of fortifications, the pavements and water supply of various cities, roads and other topics are described and in some cases profusely illustrated in this volume.

Two large volumes are required for the report and accompanying sub-report of Lieut. W. J. Borden, Chief Engineer of the City of Havana. Among the subjects covered in more or less detail, and often with many illustrations, are paving, street cleaning, refuse collection and dispcsal, parks, water supply, school buildings and hospitals.

There are a number of views of self-dumping refuse scows.

### REPORT FOR 1902, TO THE CLOSE OF AMERICAN OCCUPANCY.

In the opening sentences of this report, General Wood states that practically the same personnel had been in charge for the period covered as in 1901, and that the municipal administration steadily improved in 1902. A general review of conditions on the island is given in which is included a copy of a new railway law, issued on Feb. 7, 1902. This law provides for and defines the duties of a railway commission.

There is a large amount of interesting matter in the departmental reports, which appear to follow the same general plan as those for the year 1901.

AMERICAN STREET RAILWAY ASSOCIATION.—Proceedings of the Annual Convention Held at Saratoga Springs, September, 1903. Chicago: T. C. Pennington, Secretary, 2020 State St. Paper; 6 × 9 ins.; pp. 343; illustrated.

Such prompt publication of convention proceedings is most commendable. The principal matters of interest which are treated are as follows: The carrying of mail on street cars; recent steam turbine developments, by W. L. R. Emmet; the production and distribution of alternating current for large city systems; train orders and train signals for interurban roads; freight and express service on electric railways; the comparative merits of single and double-truck cars for city service; rules for the government of employees; electric welded joints for rails. Nearly half of the volume is occupied by lists of members and exhibitors, speeches, and the records of the formal part of the proceedings.


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## Literary Magazines.

Upon the front cover of the November "Review of Reviews" is printed the significant sentence, "What if Panama Should Revolt?" In the editorial review of current events Dr. Albert Shaw writes:

> Inasmuch as the permanent control of Panama by the politicians at the remote Colombian capital has now become wholly impracticable, it may be assumed that the movement for Panama independence affords the best solution of the situation. . . .
> The French Panama Canal Co. has been ably represented at Washington, and it is accurately informed as to the pro-Panama sentiment that prevails there. The American public may be quite sure, therefore, that the agents of this company will leave nothing undone in order to clear away existing obstacles at the earliest possible moment so as to make it feasible for the President to take the Panama route, whereas he must otherwise fall back upon Nicaragua as the law now stands.

All this must have been written at least a week and probably a fortnight or more before the actual outbreak of the revolution on Nov. 4. Dr. Shaw is generally conceded to be among the best informed writers on public affairs. In the light of present knowledge, it appears probable that he was simply stating what he knew to be facts when he intimated that the French Panama company would arrange for a revolution at Panama in order to complete the sale of its works to the United States and obtain the much desired $40,000,000. Dr. Shaw goes even farther and says substantially that the French company managers did not buy up the Bogota politicians because they had other plans in view, and he refers to "the powerful and astute array of financial, legal and diplomatic talent which this French corporation employs." He also mentions, incidentally, as "a notorious fact," that the extension of the franchise of the present Panama company was never legally granted.

All these things are of interest as showing what sort of a mess the nation is getting into at Panama. Dr. Shaw explains the pro-Panama sentiment at Washington by the statement that "among a majority of engineering experts, the belief prevails that the advantages are greatly in favor of Panama." We take the opportunity to strongly dissent from this statement of the attitude of the engineering profession on this question. The pro-Panama sentiment at Washington is better explained, we believe, by the fact that a corporation with $40,000,000 at stake is behind the Panama route, while nobody now has a dollar at stake in the Nicaragua route.

Among other articles of interest to engineers in this month's "Review of Reviews" are a paper on the Galveston sea wall, another on the new rifle for the U. S. Army, an account of the military maneuvers at Fort Riley, and a popular article on radium by Mr. Geo. F. Kunz. We may note that the new Springfield rifle weighs 9.47 lbs., has a caliber of .30, the same as the Krag-Jorgenson, uses a smokeless powder charge of 43.3 grains, and gives the projectile a muzzle velocity of 2,300 ft. per second and a muzzle energy of 2,582 ft.-lbs. The magazine contains five cartridges, and the piece can be used as a single-shotgun while the magazine is kept in reserve. The manufacture of the new arm for issue to the entire army is to begin next month, and they are to be turned out at the rate of 250 per day.

The first international wireless telegraph conference, held in Berlin last August, is described by Mr. John I. Waterbury in the "North American Review" for November. The purpose of the conference was to decide to what extent the rival systems of wireless telegraphy should be compelled to accept each others messages and co-operate with each other. The result of the conference was rather against the claims of the Marconi company to a monopoly of the business. In the same magazine Mr. Henry Michelsen defends the Government's forest reservation policy and the methods by which it has been carried out, the article being in reply to one on the opposite side of the question by Mr. Jas. P. Kimball, in the August "North American." An article of great interest to sanitarians in this magazine describes the systematic measures adopted by New York city for stamping out trachoma. Another important measure of reform which has been carried out in New York is that of tenement-house construction, and it is described in a paper in this month's "Atlantic" by Mr. Burton J. Hendrick. In the same magazine President Eliot, of Harvard University, writes on "The School," and no one interested in matters educational should fail to read what he has to say regarding the meaning and purpose of education. He writes primarily of the work done by the elementary schools; but much of what he says is applicable also to higher education.

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MECHANICAL DRAWING.—Part 1. Use of Instruments, Lettering, Geometrical Problems and Projections. By F. E. Giesecke, M. E., Professor of Drawing, Agricultural and Mechanical College of Texas. New York: Eugene Dietzgen & Co. Cloth; 6¾ × 9¾ ins.; pp. 79, including 31 plates. $1.

This book is evidently designed as a text-book for students. A sufficiently full chapter on the principal instruments used in drafting is followed by a few drafting exercises and by a dozen pages on lettering. The solutions, by drafting, of the most useful geometrical and arithmetical problems are very clearly given and the construction of ellipses, ellipsoids, parabolas, cycloids, etc., is adequately explained.

The part of the book dealing with single plane projections and development is excellent, and the subject of Axonometry, including trimetric, dimetric, isometric and oblique projection, is well presented. From a reference in the text we understood that Part II. will treat of perspective.

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COMMUTATOR CONSTRUCTION.—By William Baxter, Jr. Being No. 3 of a Series of Practical Papers. New York: The Derry-Collard Co. Paper; 5 × 8 ins.; pp. 23; 39 figures in the text.

This little essay tells how commutators are made, to what derangements they are liable, how the design should provide against mechanical and electrical derangement, and how they may be repaired when damaged. The text is clear and easily comprehensible, and the same may be said of the drawings.


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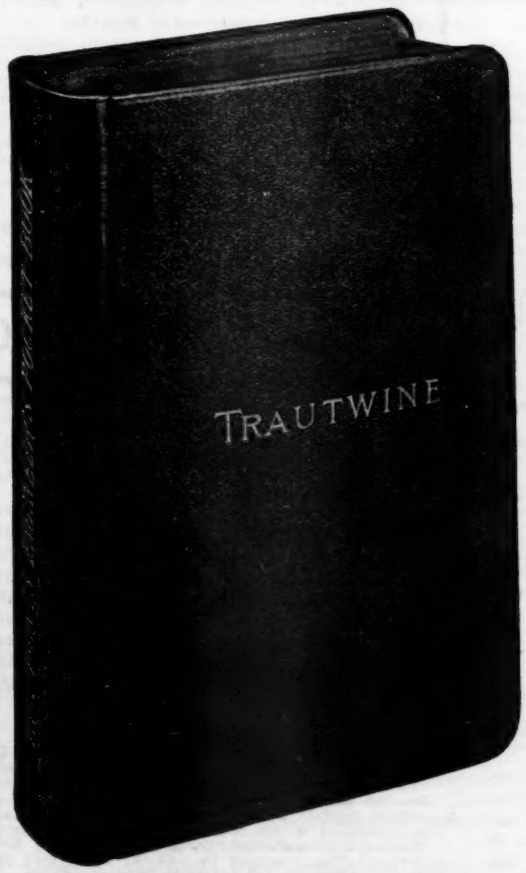


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## CORRESPONDENCE.

(Continued from p. 39.)

### A Universal Rule for Saw Log Measurement.

Sir: Some months ago I received a copy of "The Woodman's Handbook," published shortly before by the United States Department of Forestry. It contained, among other matter, a collection of above forty log rules employed in various parts of the United States and Canada in determining the number of board feet in saw logs. The extraordinary and even ludicrous discrepancies between the various log rules led me to investigate the subject to see whether there was not to be found one and only one mathematical rule that would be fair to both parties.

I believe I have found this rule. It is explained as follows: We start with a log 12 ft. long, because then every square inch in the end of the log means one foot, board measure. The log being supposed at the outset straight and round, the total volume in board feet if D represents the diameter in inches is $\frac{\pi}{4}$. $D^2 = \frac{3.1416}{4} D^2$. Subtracting one-fifth as usual for saw kerf there remains $\frac{\pi}{5} D^2$ or $\frac{3.1416}{5} D^2$ for the untrimmed boards, including slabs, in a perfect log. We must now make allowance for the slabs, edging, and we may (and I do) include an allowance for small crooks and superficial blemishes which are not important enough to call for special discount. The question now is, how such an allowance is to be reckoned for different diameters. The answer is not difficult. All these slabs, blemishes, etc., lie on the surface of the log and vary as the amount of such surface, that is, they vary as the first power of the diameter. For example, a two-foot log has twice as much surface as a one-foot log and carries on an average twice as much of slabs, edging, etc.; we must, therefore, subtract twice as much as we should for a one-foot log. This means that we are to subtract from our $\frac{3.1416}{5} D^2$ a plank of the same thickness from all logs, but of width D, equal to the diameter. At this point we must call upon the practical sawyer to help us fix upon the proper thickness for this plank. After consultation with practical sawyers I have chosen two inches, and my formula reads:

$$B = \frac{3.1416}{5} D^2 - 2D$$

or, reduced,

$$B = 0.62832\ D^2 - 2D$$

The only quantity that any one can have an excuse for changing on the score of experience is the 2; but good and experienced judges insist that the results are "just right." It covers the waste in fair, ordinary logs and leaves the buyer the very reasonable margin of safety of about 5%.

The other log rules can easily be thrown into the same form as mine, as follows. The form in full is:

$$B = aD^2 + bD + c.$$

Take from Doyle's tables, for example, the board feet corresponding to a diameter of 10 ins., 20 ins., and 30 ins. successively and we have:

$$27 = 100\ a + 10\ b + c$$
$$192 = 400\ a + 20\ b + c$$
$$507 = 900\ a + 30\ b + c$$

and we get $a = 0.75$, $b = -6$, $c = 12$; and Doyle's formula reads:

$$B = 0.75\ D^2 - 6\ D + 12$$

In the same manner,

Vermont Rule, $B = 0.50\ D^2$
New Hampshire Rule, $B = 0.41\ D^2 - 0.1\ D + 1$
Hanna Rule, $B = 0.61\ D^2 - 1.7\ D - 6$.

In all of these the lack of any reason is evident. Coefficients of $D^2$ larger than 0.628 give a rising rule, i. e. in large logs the amounts are too great; and vice versa The third term is to be added to or subtracted from every log irrespective of size!

In order to illustrate from another point of view the working of the above rules, I subjoin the figures for a 12-in. and a 48-in. log:

| | Diameter of log. | |
|---|---|---|
| | 12 ins. | 48 ins. |
| The Universal Log Rule..... | 66 | 1,332 |
| Doyle ..... | 48 | 1,452 |
| Vermont ..... | 72 | 1,152 |
| New Hampshire ..... | 58 | 939 |

It ought to be added that the last two rules were made statutory to protect the farmer! I am offering the Universal Log Rule by mail for 10 cts. in the hopes of getting back gradually the cost of printing it. As for the labor—that goes for the cause of fair play.

Yours respectfully,
Archibald Lamont Daniels, Sc. D.
Professor of Mathematics.

Burlington, Vt., Oct. 12, 1903.

(The Universal Log Rule referred to is simply a table compiled by use of the formula above given and showing the lumber contents in logs from 5 ins. to 60 ins. diameter, and from 7 to 16 ft. in length. "The Woodsman's Handbook" was noted in the issue of this Supplement for March 19, 1903.—Ed.)


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On the right-hand page of two facing pages, reproductions of line drawings of head and waste gates, flumes and accessories, a dam, and a measuring weir are shown, and on the left-hand pages there are, where obtainable, brief notes on the cost, durability and usefulness of the structures figured. The illustrations and notes relate to portions of irrigation works built in the arid region of this country during the past twenty years.

### Publications Received.

THE NEW EPOCH, AS DEVELOPED BY THE MANUFACTURE OF POWER.—By Geo. S. Morison. Boston and New York: Houghton, Mifflin & Co. Cloth; 5 x 7 ins.; pp. 134; portrait frontispiece. 75 cts. net.

MACHINE DESIGN.—Part I. Fastenings. By Wm. Ledyard Cathcart, M. Am. Soc. M. E., Adjunct Professor of Mechanical Engineering, Columbia University. New York: D. Van Nostrand Co. Cloth; 6 x 9 ins.; pp. 291; 77 tables and 119 figures in the text. $3 net.

DIE DAMPFTURBINEN.—Und die Aussichten der Wärmekraftmaschinen. By A. Stodola, Professor at the Federal Polytechnic Institute of Zürich (Switzerland). Berlin: Julius Springer. Cloth; 6 x 9 ins.; pp. 220; 119 illustrations in the text; several folding plates. $1.80.

INDEX TO JOURNAL OF THE U. S. ARTILLERY.—Part I. Index of Authors. Vols. I. to XX. Supplement to No. 62. Fort Monroe, Va.: Artillery School Press. Paper; 6 x 9 ins.; pp. 29.

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COMMERCIAL AND AGRICULTURAL ASSOCIATIONS.—Lists of National, State and Local Commercial and Agricultural Associations. Compiled by the Interstate Commerce Commission. Washington: As above. Paper; 6 x 9 ins.; pp. 296.

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UNIFORM MUNICIPAL ACCOUNTING AND STATISTICE.—A Paper Read at the Detroit Conference for Good City Government by Dr. Edward M. Hartwell, of Boston, Chairman National League Committee on Uniform Municipal Accounting and Statistics. Philadelphia: National Municipal League. Paper; 6 x 9 ins.; pp. 21.